...ch, 1953 TECHNICAL ... TWO SHILLINGS & SIXPENCE

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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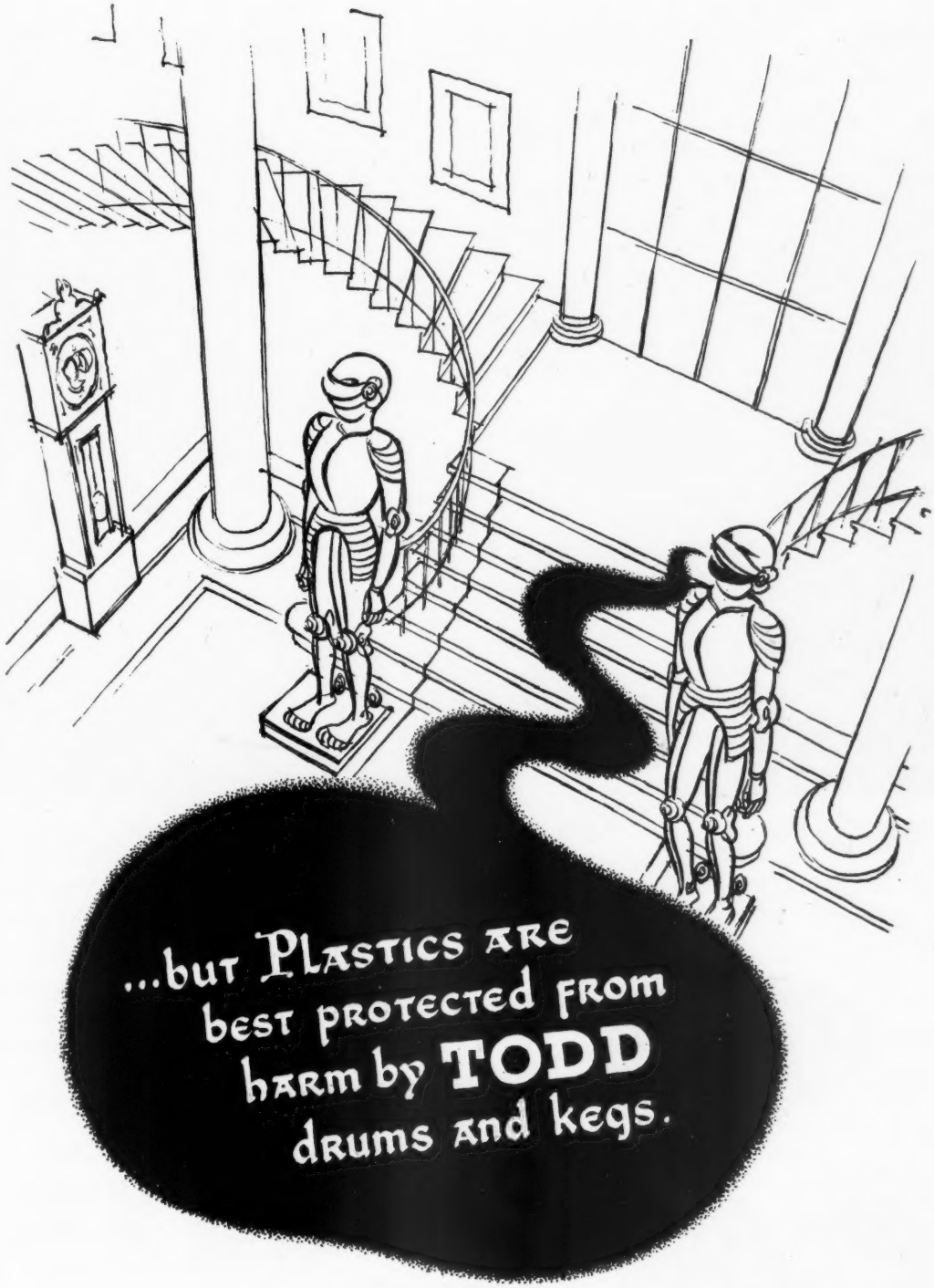
POLYSTYRENE

Manufactured by Plastic Engineers Limited, for Industrial Appliances Limited—exclusive holders of the patented 'press-click' opening action.

The containers are used by the Kores Manufacturing Co. Ltd., as packs for their Pegasus Typewriter Ribbons.

ERINOID LIMITED · STROUD · GLOUCESTERSHIRE



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TODD BROS. (St. Helens & Widnes) LTD., WIDNES, LANCS.

Telephone No.: **WIDNES 2267 (2 Lines).** **ST. HELENS 3271 (3 Lines).**

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made easy for short runs

IN LOW TEMPERATURE THERMOPLASTICS

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LOW PRODUCTION COST

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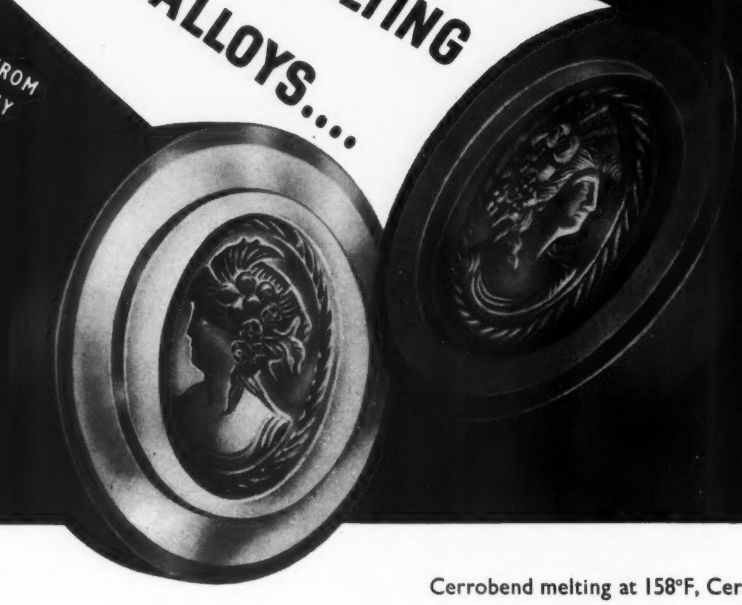

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NO HIGHLY SKILLED LABOUR

Cerrobend melting at 158°F, Cerrobase at 255°F and Cerrotru at 281°F are easily sprayed against master models with inexpensive equipment. The resultant negative cavity, reproducing the finest detail, provides excellent mould for short runs in thermoplastics. After use moulds may be re-melted and metal fully recovered.

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Low-Temperature-Melting Non-Shrinking Alloys ALLOYS

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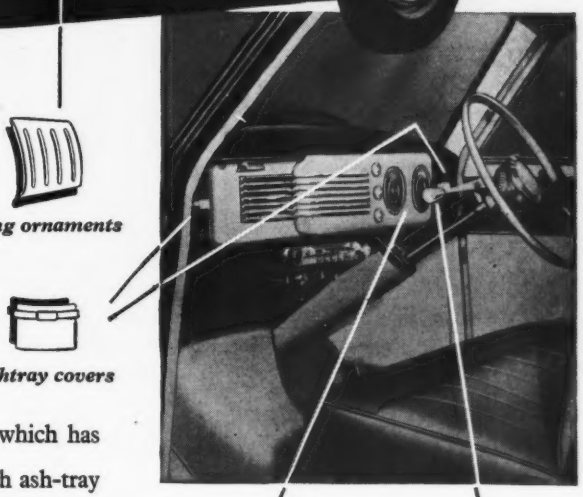
MANFIELD HOUSE — 376 STRAND — LONDON — W.C.2

Such well-moulded features!



Wing ornaments

Ashtray covers

Instrument dials

Gear lever knob

THE SUPERB NEW VAUXHALL features no fewer than eleven Ekco mouldings, both compression and injection. The edge-lit instrument dials are of transparent Diakon; the gear-lever knob, which has an internal thread, is of cream urea; and the flush ash-tray covers and the wing ornaments are of brown and black phenolic respectively. The whole of this moulding programme was carried through smoothly and economically by the Ekco Plastics 'start-to-finish' service, which specializes in making life easier for manufacturers of practically anything. If, then, you have a problem involving one or many different types of moulding, or a production problem to which plastics may provide the solution, you are cordially invited to transfer your worries to the broad backs—and minds—of Ekco Plastics!

EKCO *Plastics for Industry* Ⓔ

Members of the British Plastics Feaeration

B.I.F. CASTLE BROMWICH
STAND Nos. 314/315

E. K. COLE LTD. (*PLASTICS DIVISION*), SOUTHEND-ON-SEA, ESSEX

Telephone: Southend 49491

Opening a NEW field in P.V.C. Technology:

"VINAGEL"

. . . a series of P.V.C. compounds providing NEW and more economical techniques in calendering, moulding, embossing, extruding, stamping, cold-dipping, etc.

"VINAGEL" is a new material based on Polyvinyl Chloride, with the characteristics of putty for hand-modelling and low pressure processing, or having the consistency of low viscosity paste for cold-dipping. It retains its shape without the use of moulds or other expensive processing equipment during the heat treatment at temperatures of 150° - 170° C.

- ★ **Can be extruded, calendered, coated, stamped and moulded on low-pressure cold processing machinery prior to fusion.**
- ★ **After fusion forms tough resilient products which withstand high temperatures in normal use without deformation.**
- ★ **Can be used for cold-dipping without pre-heating the object to be dipped.**
- ★ **Can be shaped on clay or pottery plant before heat treatment without the aid of moulds or cases.**

OTHER APPLICATIONS of this amazing material include Prototypes and models, Gaskets, Packing Glands and Rings, Conveyor Belts, Tiles and Floor Coverings; permanent flexible Moulds for plaster, cement and cast resins; impression Moulds from ornaments and decorations, hard or flexible articles such as Toys, Display components, protection of metal articles by cold-dipping.

There appears no limit to the ultimate possibilities of "VINAGEL". We shall be pleased to provide experimental quantities in a variety of grades and colours according to the nature of your requirements. Tell us your problem and we will advise you on the use of "VINAGEL".

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VINYL PRODUCTS LTD.

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Are you harbouring scrap P.V.C., Cellulose Acetate, Polyethylene, Polystyrene or "Perspex"? We welcome all clues that lead us to these, or any kind of thermoplastic scrap and surplus material. Let us know the kinds and quantities you have to offer.

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Telephone: ROY*al 7654 (6 lines)* *'Grams: Mulbright, London*

Sole agents in Great Britain, France and Spain for H. Muehlstein & Co. Inc., New York.

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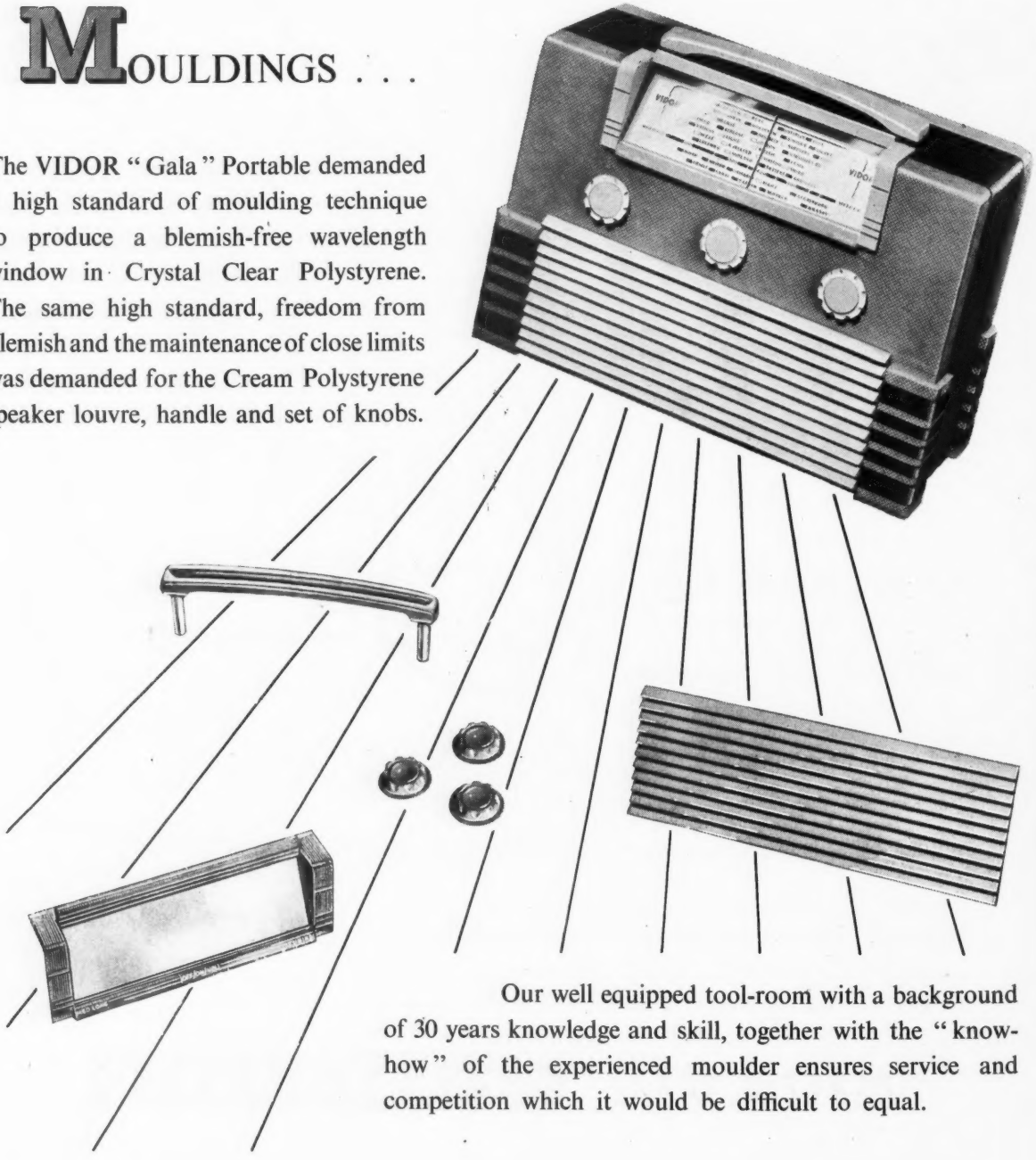
The VIDOR "Gala" Portable demanded a high standard of moulding technique to produce a blemish-free wavelength window in Crystal Clear Polystyrene. The same high standard, freedom from blemish and the maintenance of close limits was demanded for the Cream Polystyrene speaker louvre, handle and set of knobs.



Our well equipped tool-room with a background of 30 years knowledge and skill, together with the "know-how" of the experienced moulder ensures service and competition which it would be difficult to equal.

W. W. BALL & SONS LTD.

BURSTEAD WORKS • KENNEL LANE • BILLERICAY • ESSEX

PHONE: BILLERICAY 411/12 GRAMS: PLASTOOL, BILLERICAY

A MOULDING THAT HAS AROUSED
GREAT INTEREST IN THE TRADE

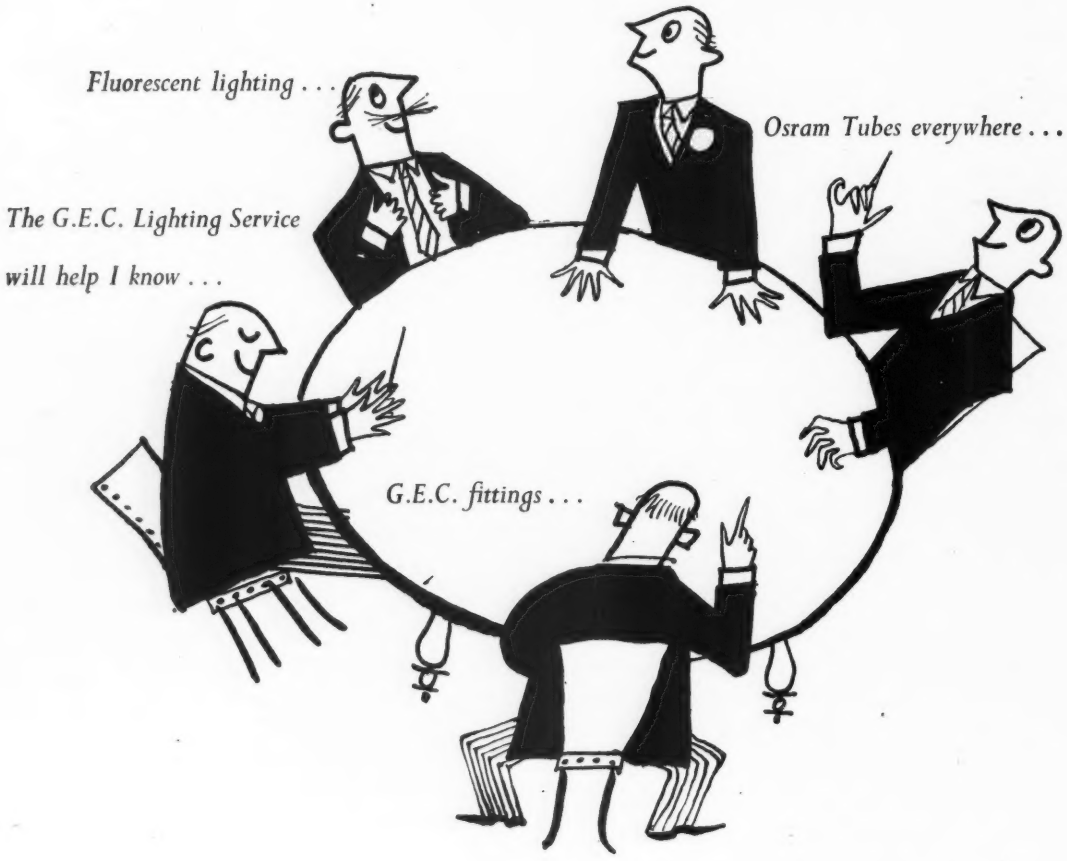
Goya's attractive powder bowl, which has won so much admiration in the cosmetic trade, is injection moulded from the recently introduced "Distrene 200X." This new polystyrene possesses outstanding flow properties, which have been increased without sacrificing toughness, heat resistance and high dimensional stability. It is, therefore, a true dual-purpose material: while it will faithfully reproduce the most intricate designs, it is equally ideal for general purpose mouldings where fast cycles are required. "200X" is available in the full range of "Distrene" colours — clear, translucent and opaque. Please write for samples and further information. (Powder bowl designed by Goya Ltd. and moulded by British Artid Plastics Ltd. from "Distrene 200X.")

DISTRENE 200X
POLYSTYRENE
INJECTION MOULDING MATERIAL

BRP BRITISH RESIN PRODUCTS LIMITED

Sales & Technical Service, 21 St. James's Square, London, S.W.1. Tel: WHI 8021-7. ("Distrene" is a Registered Trade Mark.)

Agreed then?



Fluorescent lighting?

Fluorescent lighting is the clearest, kindest working light. And by far the most economical. It would maintain your present lighting standard with a saving on current of over 50% — or, should you need brighter lighting, it would give you over double the brilliance without raising consumption! Why not go into the whole question with the G.E.C. Advisory Lighting Service? The G.E.C. have always led in fluorescent development and have unrivalled technical knowledge. For superb modern lighting — see the G.E.C. first.

Osram

tubes in G.E.C. fittings

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....COLOUR & ENDURANCE....

..... Matthey CADMIUM PIGMENTS

Matthey cadmium pigments—ranging from greenish yellow through orange and red to a deep maroon—are as remarkable for their endurance as for their brilliance. To their power of resistance to the action of heat, mineral acids, alkalis and solvents is added great colouring power and exceptional light fastness.

Literature describing Matthey cadmium pigments and their applications is free on request. In addition we welcome enquiries regarding any pigmentation problems.

Johnson Matthey

JOHNSON, MATTHEY & CO., LIMITED, HATTON GARDEN, LONDON, E.C.1

Telephone : HOLborn 6989

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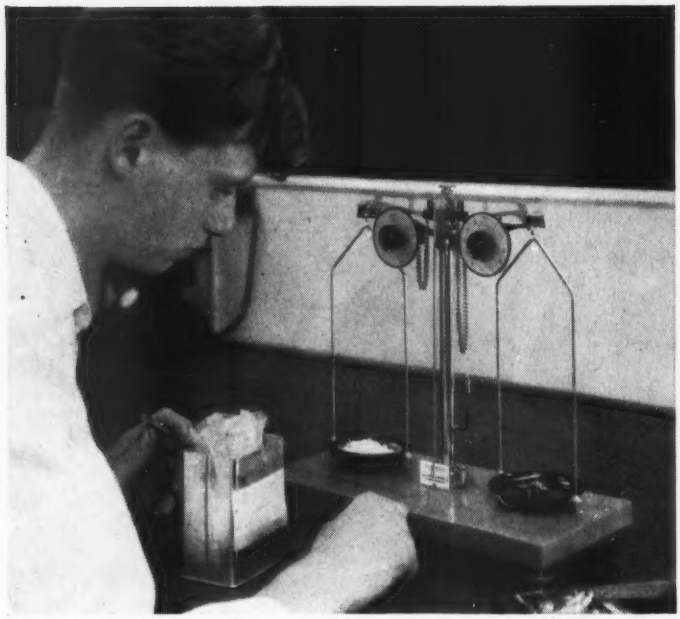


1 *Weighing dye for Colourant Blend mixing.*

2 *Filling drum tumbler with Colourant Blend.*

The LUSTREX* Dry Colourin

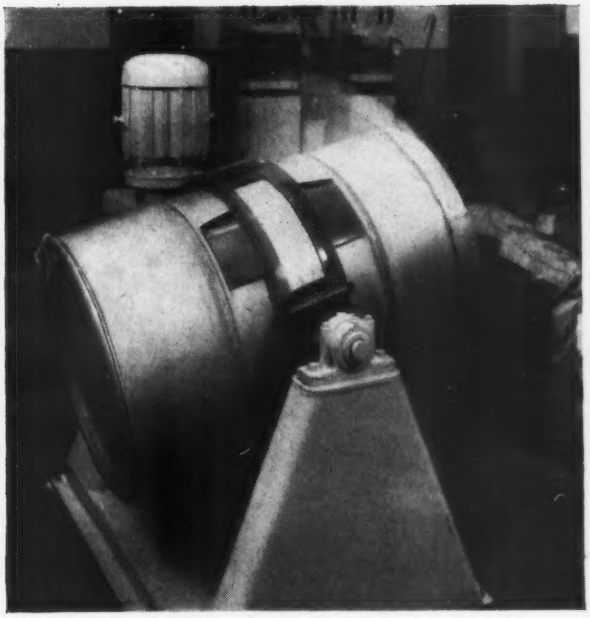
A simple, economical method of colou
polystyrene to any shade you w

THE economic advantages of Monsanto's Lustrex Colourant Bl
are being more and more widely appreciated in the industry si
the advent of this versatile form of polystyre
The outstanding virtue of Lustrex Colourant Blend is the extreme simpli
with which it can be used in the dry colouring process. The only extra equipm
required is a simple drum tumbler which will handle a charge of 50-150 lbs. of polystyr
and a balance on which the dyes can be weighed. Processing is easy. After mi
under controlled conditions, the dyestuff adheres uniformly to the surface
the Colourant Blend granules. The material can then be removed and
directly into the injection moulding mach
Our series of illustrations shows these operations, step by s

But simplicity is not the only attraction of Lustrex Colourant Bl
Consider these points, too

Colouring costs are so low that savings of many pence per lb. can be m
compared with coloured moulding powders. Colourant Blend is supplie
exactly the same price as Lustrex general moulding grade crystal. Any co
can be produced at short notice. This permits greater flexibility of operat

Adding dye to Colourant Blend in drum tumbler.



4 *Drum tumbler in operation.*

rinprocess

Only a comparatively small stock of crystal need be carried produce all the shades desired. Leading moulders in the S.A. have found it possible to reduce stocks by as ch as 75%.

rough the use of Lustrex Colourant Blend, it is now sible to produce — at reduced cost — a wide range of s, novelties, houseware and miscellaneous articles which e previously moulded from processed colours.

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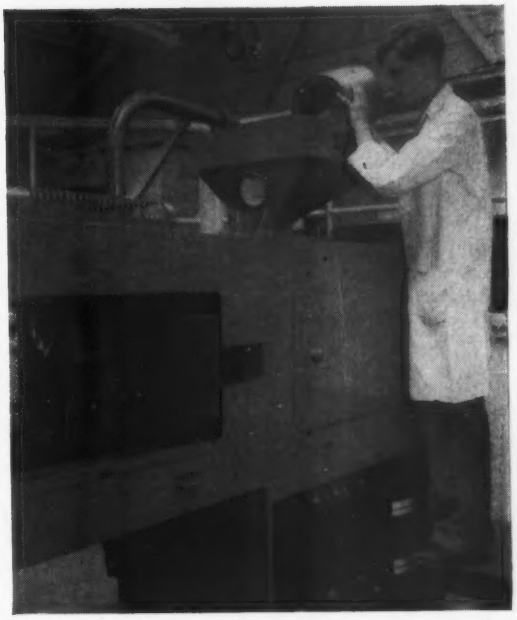
*(*Aroclor and Lustrex are Registered Trade Marks)*



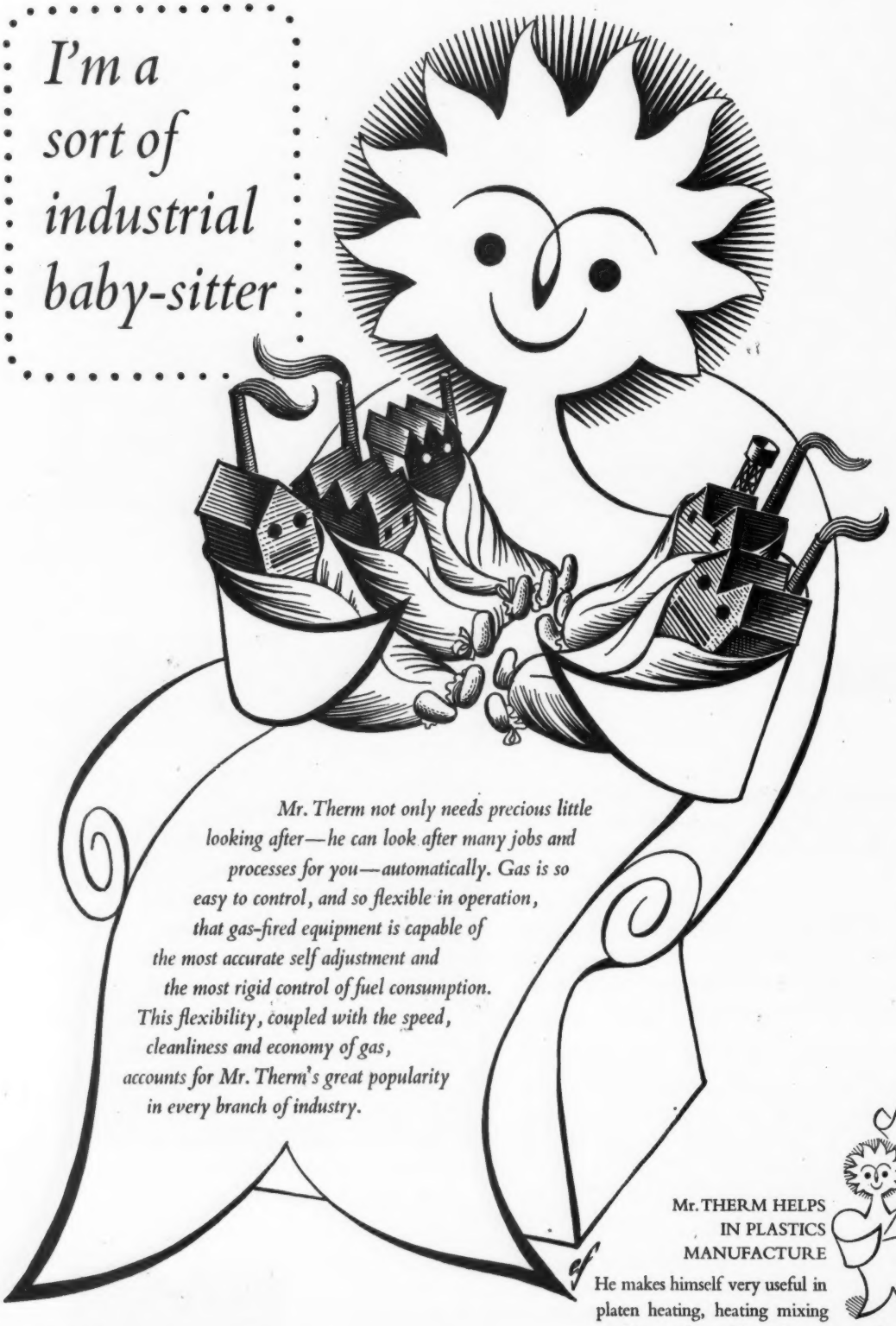
5 *Charging the injection moulding-machine hopper with Colourant Blend.*

MONSANTO CHEMICALS LIMITED,
Victoria Station House, Victoria Street, London, S.W.1.

sociation with :— Monsanto Chemical Company, St. Louis, U.S.A. Monsanto Canada Ltd., Montreal. Monsanto Chemicals alia) Ltd., Melbourne. Monsanto Chemicals of India Ltd., Bombay. Representatives in the world's principal cities.

MONSANTO

I'm a sort of industrial baby-sitter



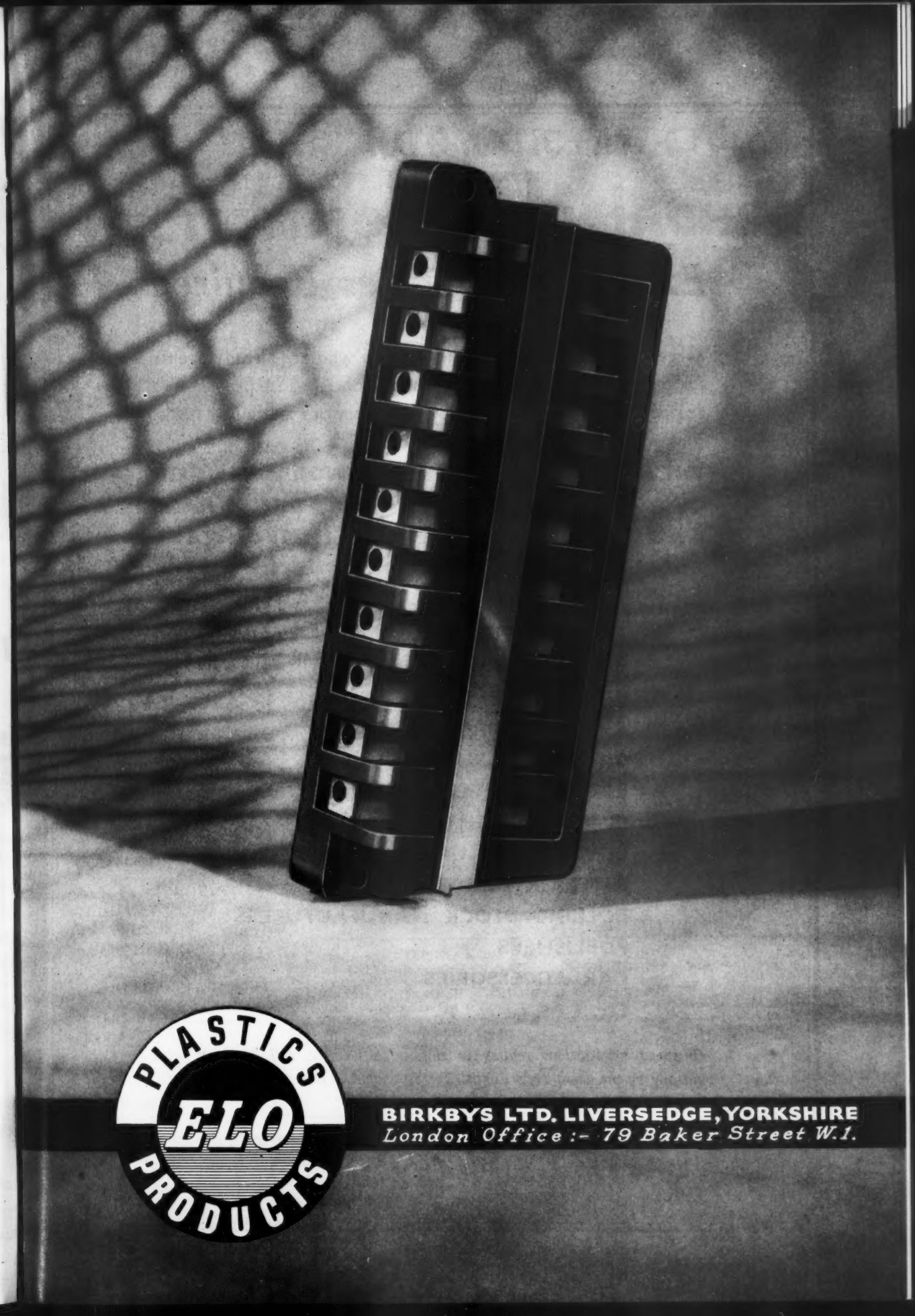
Mr. Therm not only needs precious little looking after—he can look after many jobs and processes for you—automatically. Gas is so easy to control, and so flexible in operation, that gas-fired equipment is capable of the most accurate self adjustment and the most rigid control of fuel consumption. This flexibility, coupled with the speed, cleanliness and economy of gas, accounts for Mr. Therm's great popularity in every branch of industry.

Mr. THERM HELPS IN PLASTICS MANUFACTURE

He makes himself very useful in platen heating, heating mixing machines and moulds, preheating powders before moulding and the curing of vulcanised products.

Mr. Therm burns to serve you

THE GAS COUNCIL, 1 GROSVENOR PLACE, LONDON, SW1



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London Office :- 79 Baker Street W.1.

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Exclusive Agencies Required

Large and well-established Italian house who are already agents for one of the largest British chemical concerns, are prepared to accept further agencies for Italy in the plastics and allied fields.

THE ADVERTISERS REQUIRE TO WORK ON THEIR OWN ACCOUNT NOT ON A COMMISSION BASIS AND WOULD PURCHASE IMMEDIATELY ADEQUATE STOCKS.

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To speed negotiations replies to this advertisement will be dealt with initially by the Company's English correspondent in the strictest confidence.

Replies to **Box No. P861 c/o "Plastics"**
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THE DOWDING AUTOMATIC *FAST-CYCLING*

INJECTION MOULDING MACHINE

As far ahead of other machines as the COMET!

- 1,200 CYCLES PER HOUR
- FULLY AUTOMATIC AND FOOLPROOF
- FAST PLASTICIZING AT UNUSUALLY LOW INJECTION PRESSURE
- AUTOMATIC LUBRICATION
- 3-ZONE CYLINDER HEATING
- VICKERS HYDRAULIC EQUIPMENT
- **BRITISH MADE**
- *EARLY DELIVERY*

SPECIFICATION

MACHINE CYCLES PER HOUR (Max.)	1,200
APPROXIMATE WEIGHT OF MATERIAL PLASTICIZED PER HOUR (Dependent upon weight per shot and material used)	22 lb.
MAXIMUM WEIGHT OF MOULDING PER SHOT (Acetate)	2 oz.
Area of Injection plunger	2·074 sq. in.
Pressure per square inch on material at end of plunger	9,100 lb.
Total pressure on Injection plunger	18,850 lb.
Mould opens (adjustable)	9 in.
Maximum die space	7 in.
Minimum die space	3 in.
Maximum recommended casting area in mould	15 sq. in.
Size of die plates	10 × 16 in.

DOWDING & DOLL LTD GREYCOAT STREET, LONDON, S.W.1

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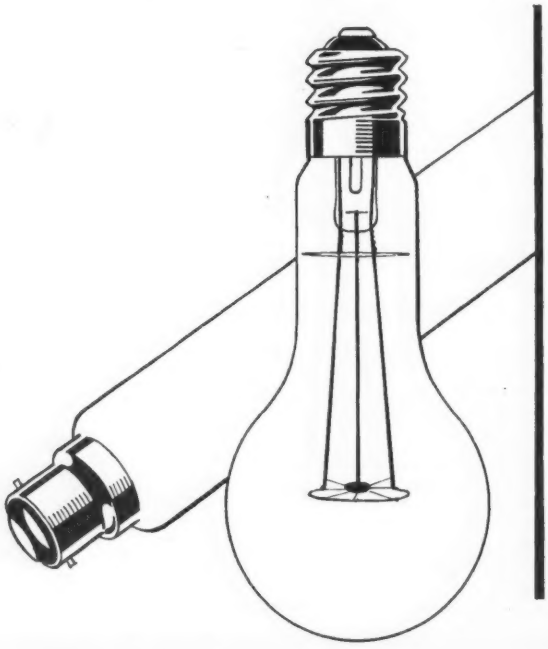
Switch to

Crompton *LAMPS*

for every industrial purpose



Here's why

What you get out of a lamp depends on what is put into it. In Crompton lamps this means the best material, tested at every stage of manufacture and backed by lighting experience that spans nearly 75 years.

That is why you get full light output for a long life from Crompton lamps.

BY APPOINTMENT MANUFACTURERS OF ELECTRIC LAMPS TO THE LATE KING GEORGE VI

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Crompton Parkinson LIMITED

CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2

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GLASS FABRIC LAMINATES

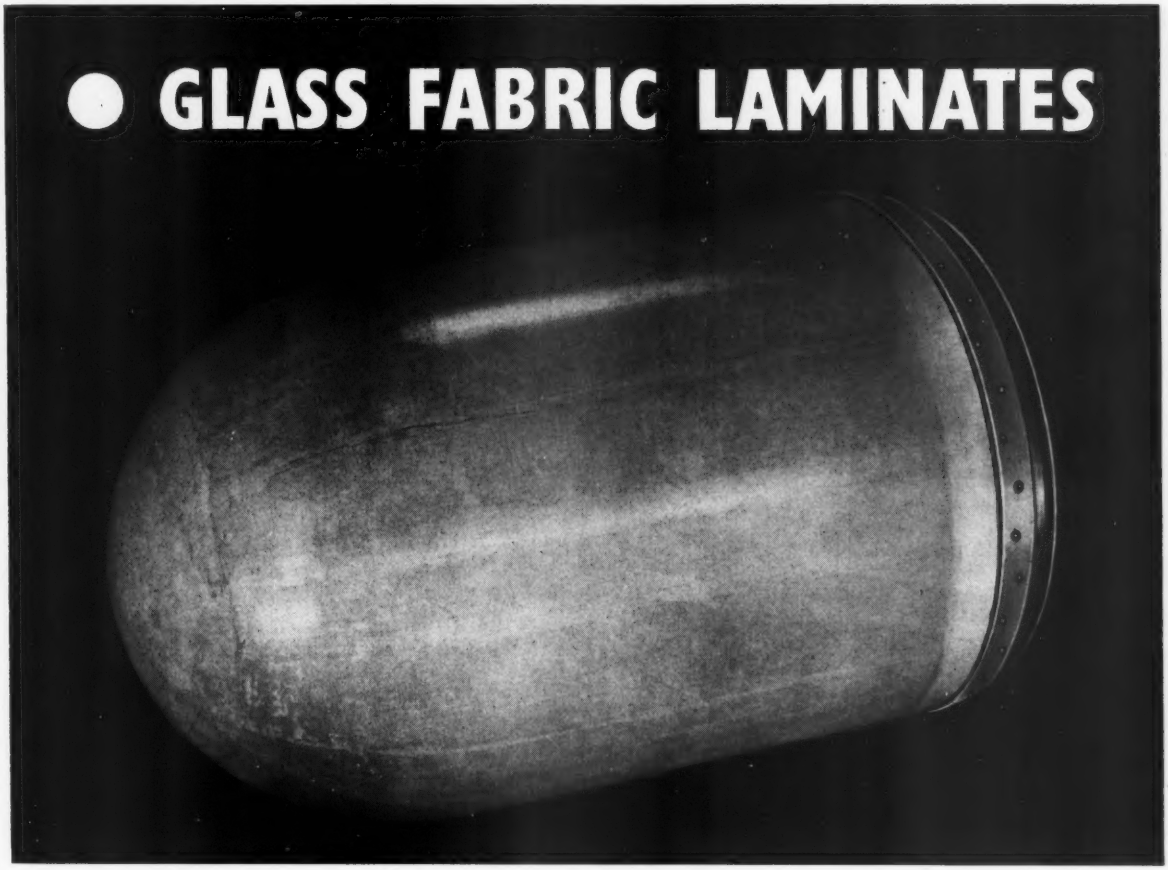

Illustration of radome we are at present producing.

We are the leading producers of Glass Fabric Laminates in this country and specialise in the manufacture of these in various grades both as standard lines and to customers own specification. We will be pleased to advise you on a suitable laminate for any application where strength and electrical or chemical resistance are of paramount importance.

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Telephone: DUNSTABLE 686/7/8 and 777 *Telegrams:* THERMOPLASTICS, DUNSTABLE

MOULDERS AND FABRICATORS OF ALL PLASTIC MATERIALS.

Specialists in Perspex fabrications, glass laminates and bonding of rubber to Perspex and metal, compression and injection mouldings in Bakelite, Urea, Formaldehyde, Polythene, Polystyrene, Cellulose-Acetate, etc.

TP DUNSTABLE

Alcohols *for plasticiser manufacture*

ALPHANOL 79
A mixture of C_7-C_9 primary alcohols with a mean molecular weight of approximateiy 125
NONANOL
Consists essentially of 3, 5, 5-trimethylhexanol-I with a mean molecular weight of approximately 144

Esters based on these alcohols are excellent plasticisers for PVC and give exceptional flexibility, outstanding low temperature characteristics, and high stability. Samples of phthalate and sebacate esters may be obtained from the plasticiser manufacturers. Further information on these and other applications, including surface coatings, may be had from

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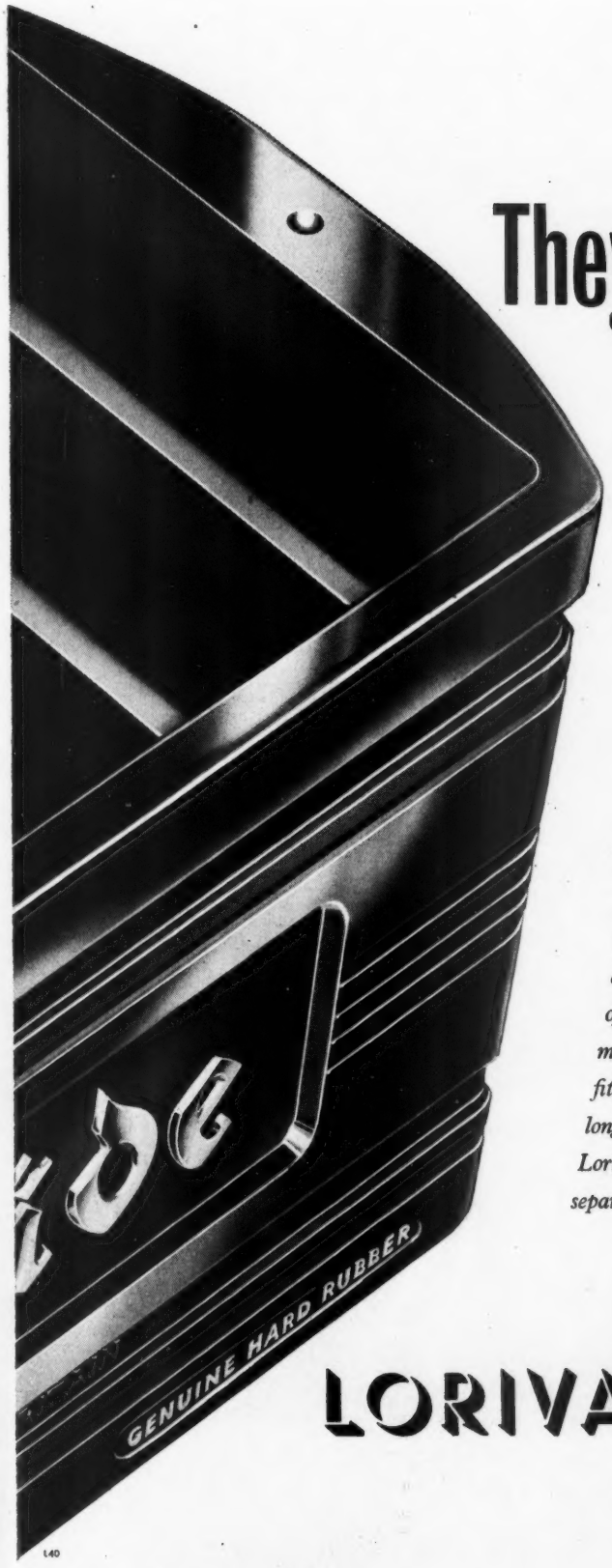
SHELL

"ALPHANOL" is a Registered Trade Mark



They're lively lads at Lorival...

Modern plastic moulding methods have been applied by Lorival to hard rubber mouldings. Exide leave it to Lorival — so can you.

Among the special features of the new Silver Exide car battery, the high quality hard rubber container plays an important part with its excellent electrical and acid-resisting qualities. The first-class appearance of the container represents a new standard of hard rubber moulding technique. The Porvic microporous separators fitted between the plates are another important factor in this long-life Exide Battery.

Lorival make Silver Exide hard rubber containers, Porvic separators, the hard rubber cell lids and polystyrene vent plugs.

LORIVAL PLASTICS

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"SPEEDICUT"
FIRTH BROWN TOOLS
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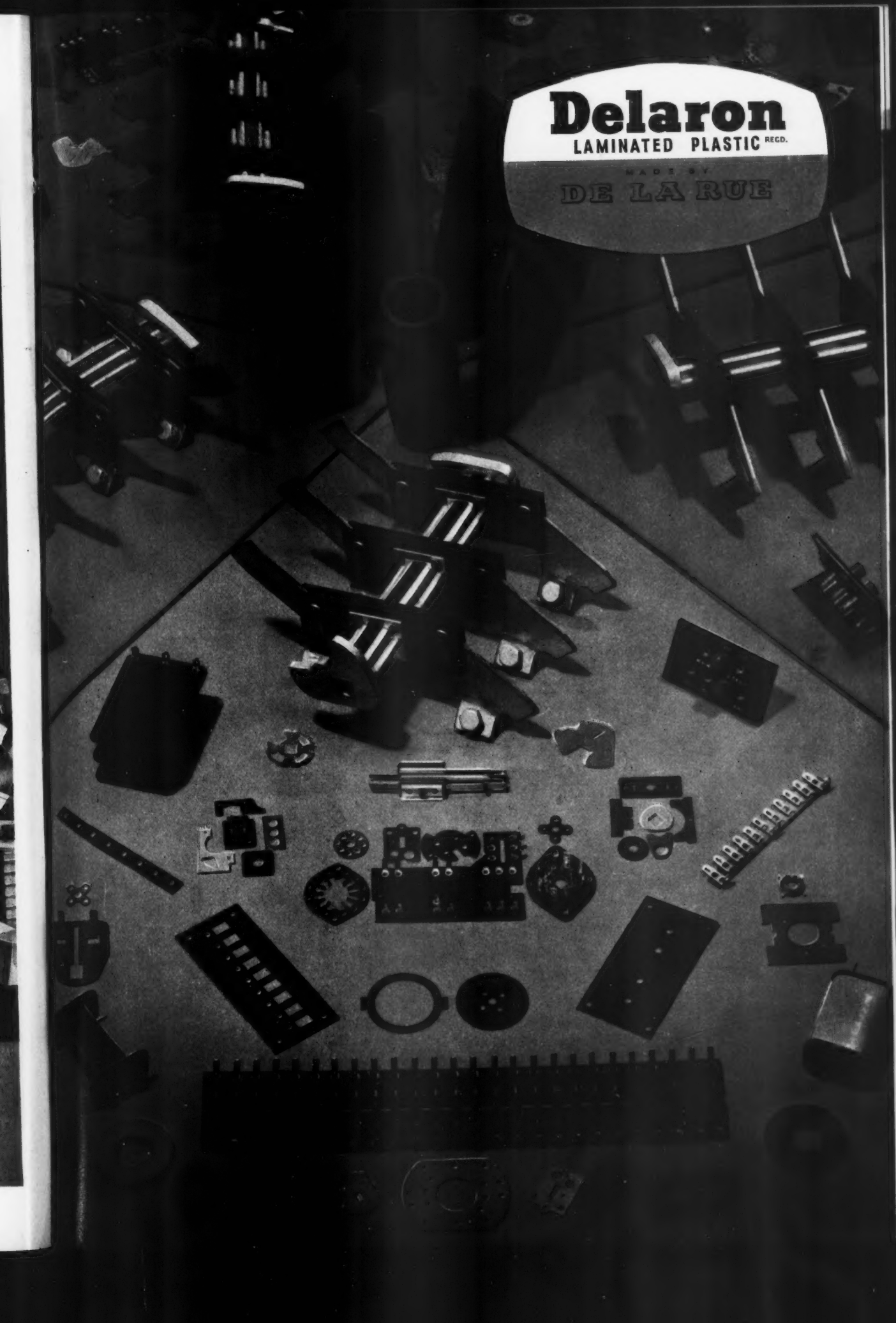
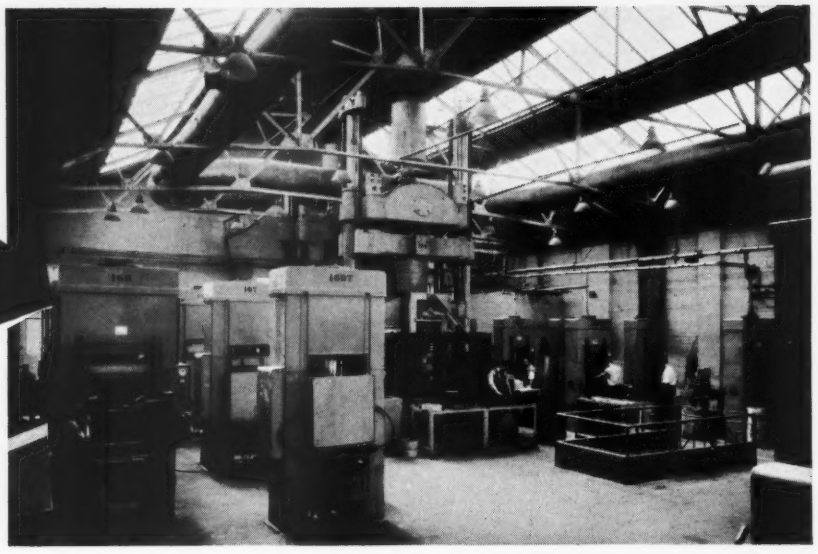
SPEEDICUT WORKS. CARLISLE ST. EAST. SHEFFIELD.


Delaron
LAMINATED PLASTIC REGD.
MADE BY
DE LA RUE

Over to BIPEL



The BIPEL system sets new standards in economy, performance and plant layout.

When planning to re-equip, remember that BIPEL was *first* with presses offering a choice of three moulding pressures; *first* with a unique drive unit—cheaper to buy, install and operate; *first* with the press-button, auto-controlled moulding cycle.

What does that mean in practice? Compare these two photographs—both taken in the same works. You can imagine the improvement in working conditions. An improvement in economy, reliability and performance that runs through the whole installation. For BIPEL moulding is more than a range of equipment: it is a complete system of hydraulic moulding, catering for the special needs of the individual moulder.

Scenes such as that shown in the top photograph are by no means uncommon in the moulding shop of today. The BIPEL system transforms the moulding shop into a clean, efficient working unit; it reduces operating costs, ensures production of mouldings of standard excellence.

The second photograph shows a typical BIPEL installation. The guard rails at right indicate the entrance to the underground chamber housing the drive units. Four units are installed, any three of which will be able to drive the forty presses ultimately to be installed.

It pays to

Invest in THE BIPEL SYSTEM *of hydraulic moulding*

B.I.P. ENGINEERING LTD.,
ALDRIDGE ROAD, STREETLY, STAFFS.

B·I·P GROUP

THE VERSATILE PLASTIC

No need to state the virtues of polystyrene. It is accepted all over the world for its versatility . . . its adaptability. At long last the designer has been given a moulding powder reasonably free from limitations.

No need either to state the virtues of Kleestron. Enough to say it is made by Kleemann's in their new factory at Welwyn Garden City and is being sold . . . and moulded . . . and praised all over the world.

O. & M. KLEEMANN LTD.

Sole Selling Agents for United Kingdom :

EAST ANGLIA PLASTICS LTD

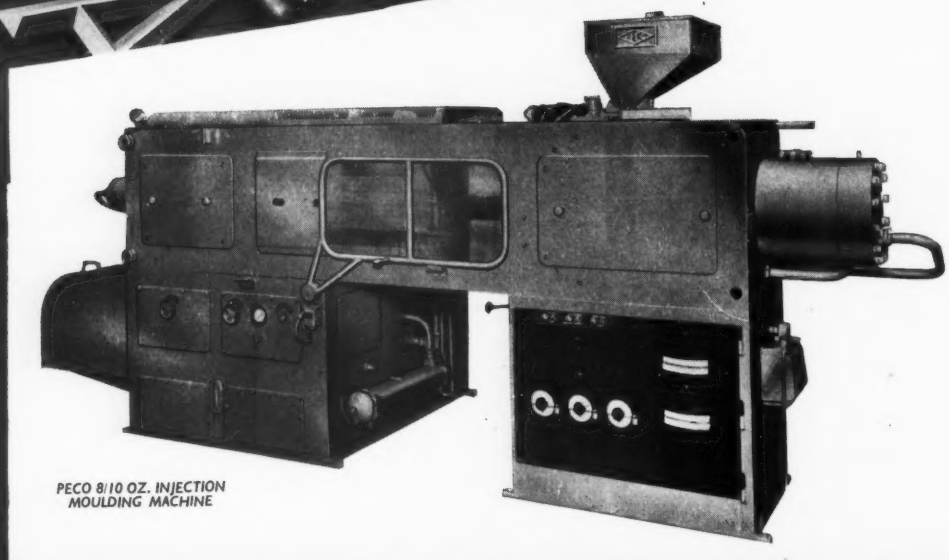
52 Brook Street, London, W.1

All Overseas and Export enquiries to : O. & M. KLEEMANN LTD., West Halkin Hse., West Halkin St., London, S.W.1

facts that speak for themselves

12,000 SHOTS *per* WEEK

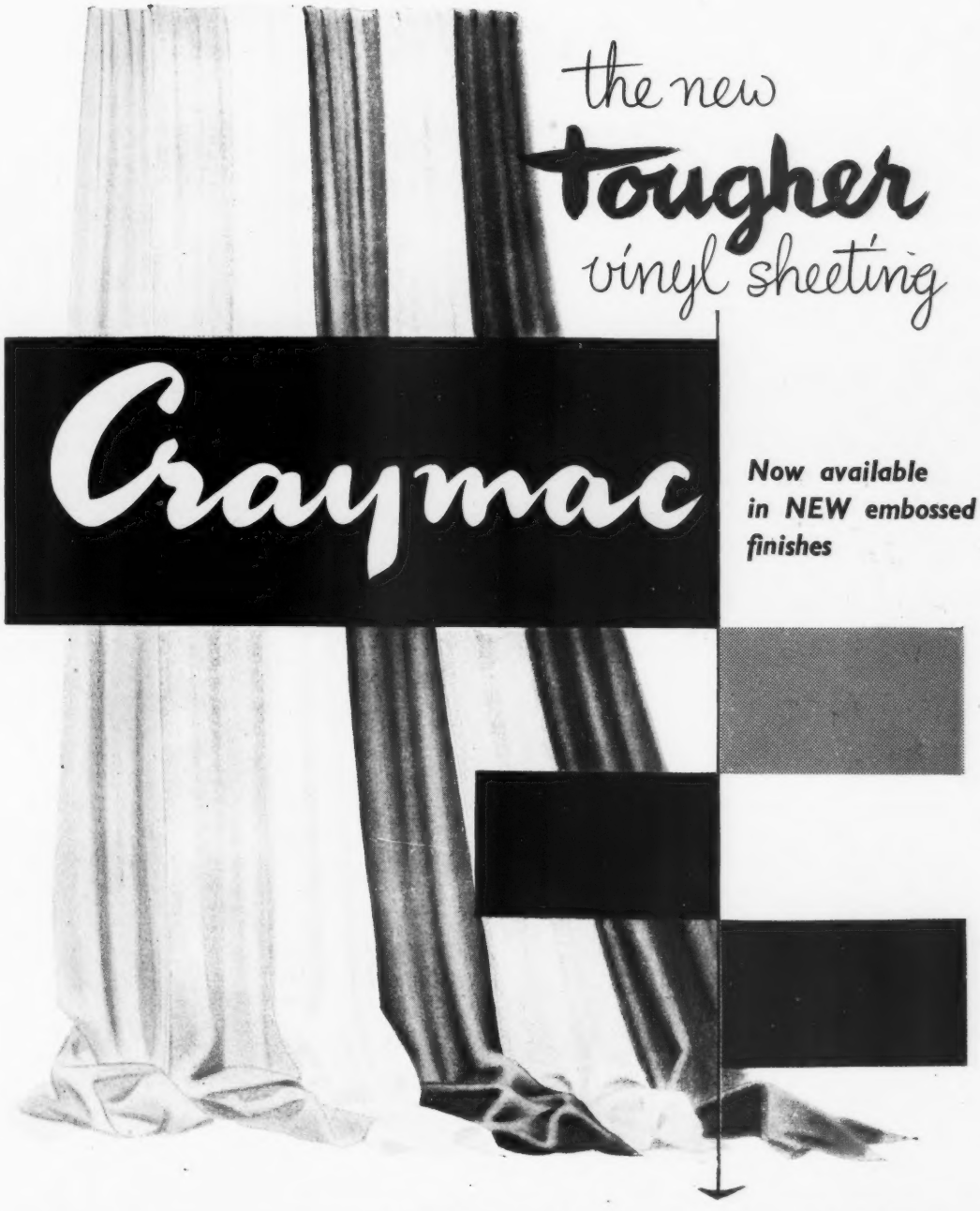
8-impression moulding in polythene, of automobile number plate digits and letters. Mould designed and mouldings produced by the Mentmore Manufacturing Co., Ltd. in conjunction with Hills (Patents) Ltd. under Patents Nos. 661276 and 661354.



PECO 8/10 OZ. INJECTION MOULDING MACHINE

PECO PRODUCTS

THE PROJECTILE & ENGINEERING COMPANY LTD.



Craymac is noted for its toughness, its soft, *silky* drape and pliability, water resistance and fast *brilliant colours*. These qualities together with its versatility are the cause of an ever growing demand for this well known vinyl sheeting. Craymac complies with the British Standards Institution No. 1763.

Serial No ★ 1923
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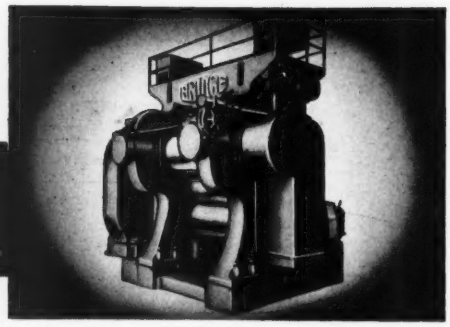
KNOWLES

Precision Calender with three superimposed and one offset roller. Flood lubrication.



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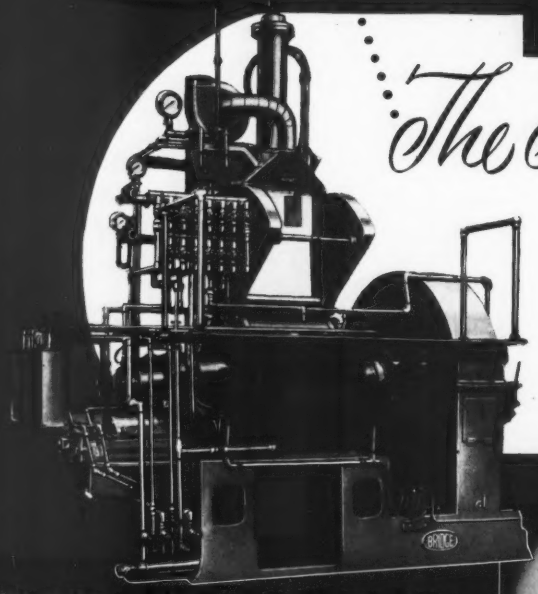
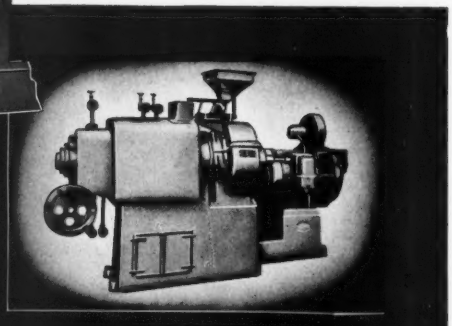


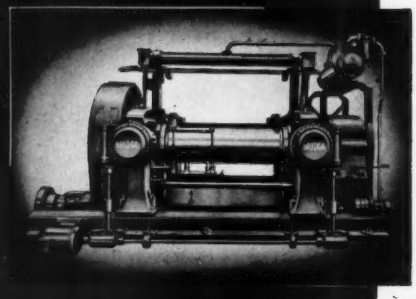
The Bridge — Banbury Patent Mixer. (1)

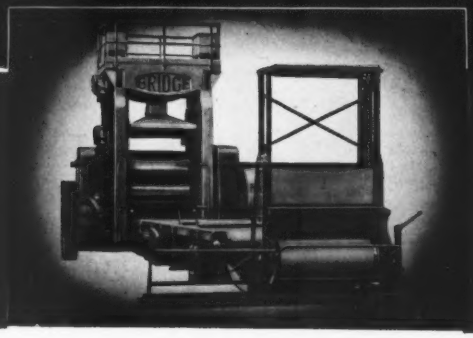
4½" Cold Feed Plastics Extruder. (3)



Precision Calender with four superimposed rollers. Flood lubrication. (2)

High temperature 22" x 60" Plastics Mill with flood lubrication. (4)





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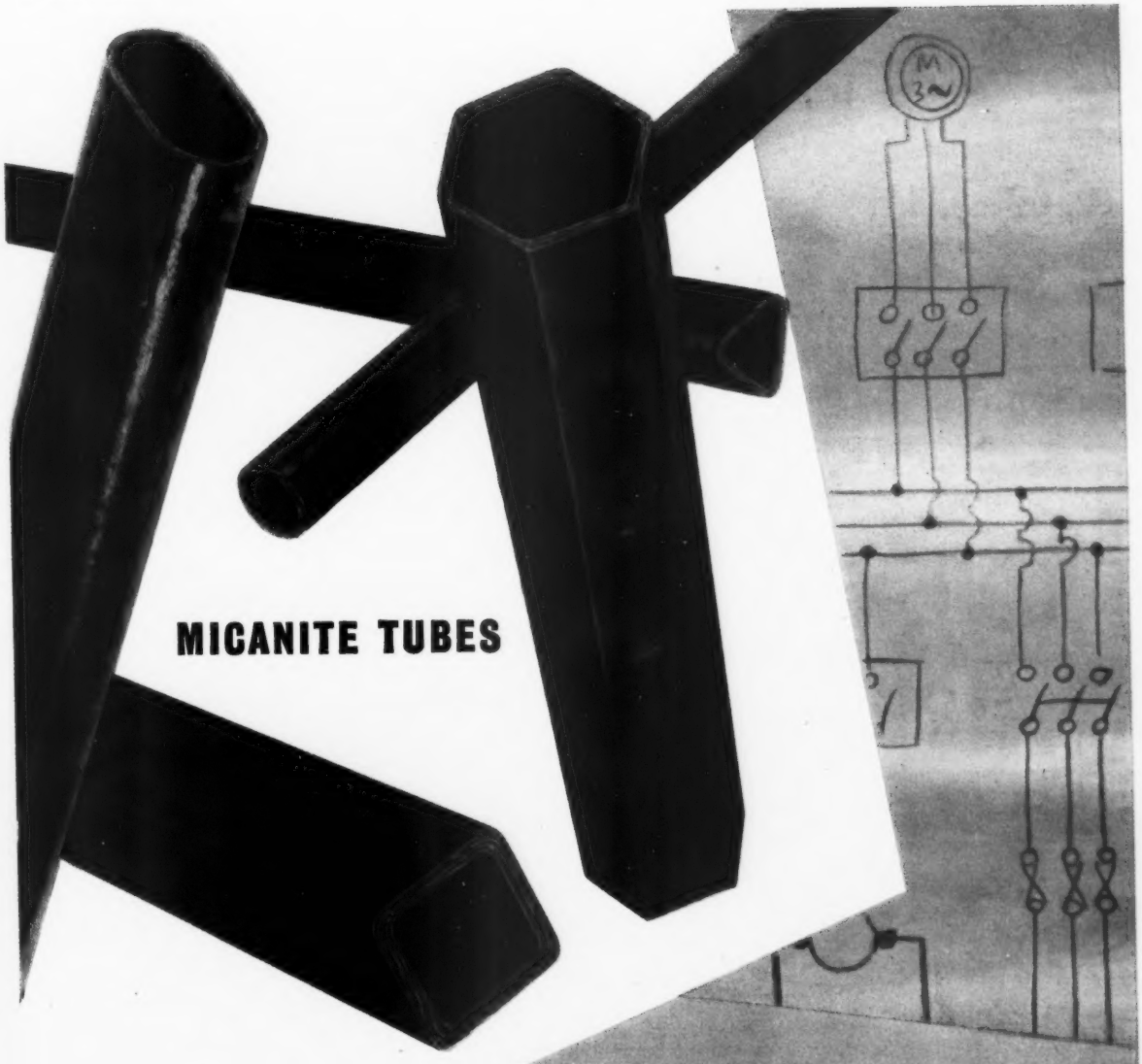

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Tensile Strength (lb./sq. in.)	6,000—8,000
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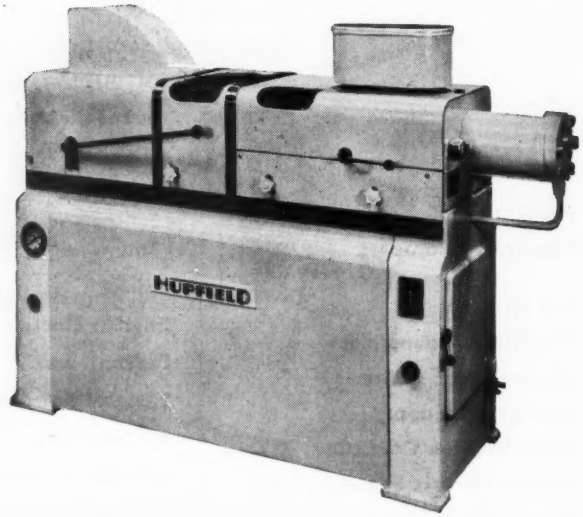

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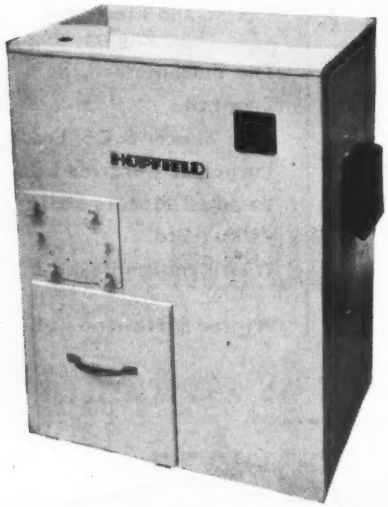

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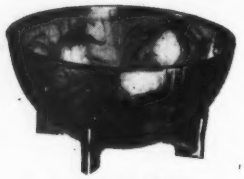
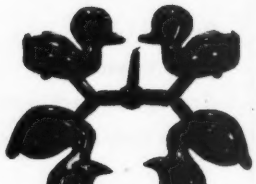
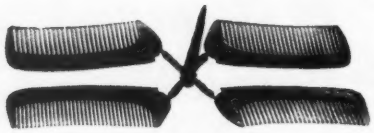


polystyrene 3¾" dia.
25 seconds. 1 ounce.



cellulose acetate 5½" × 5"
30 seconds. 31 gramme.



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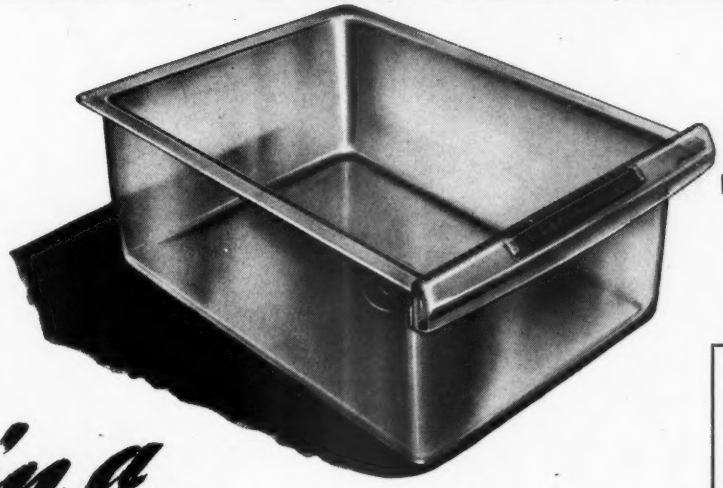

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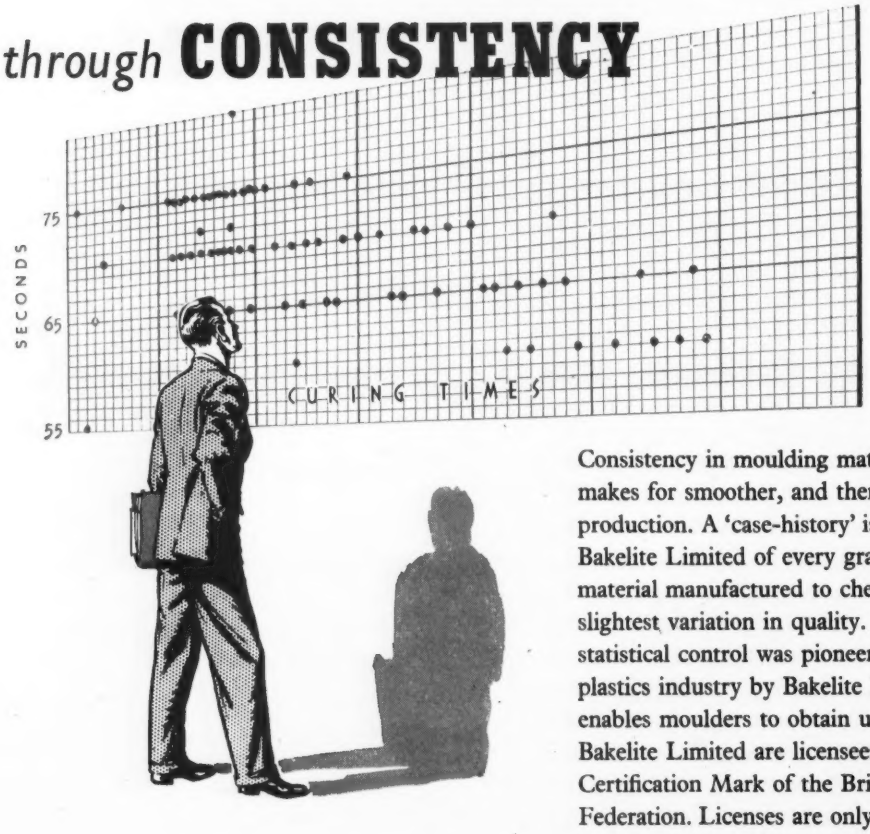

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P57

Plastics

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CONTENTS

	Page
Editorials	69
Moulding Powder and Shot	70
Welded Packs for New Coins	71
Productivity Team Report—Plastics Moulding	73
A New Application of Plastics to Printing	76
Plastics in the Service of Man	78
Relieving Stresses in Polystyrene by Heat Treatment, by E. E. Halls	81
Art in Industry	82
Letters to the Editor	83
World's Industry Employs Plastics	84
Coronation Souvenirs	85
Vinyl-type Polymers in Surface Coatings, by W. A. Edwards, M.A., F.R.I.C.	86
Tensile Impact Properties of some Plastics, by B. Maxwell, T. P. Harrington, R. E. Monica	88
New Productions	92
Production News	93
Edwards Vacuum Coating Plant	96
British Plastics Federation, Annual Report, 1952	98
Patent Review	99

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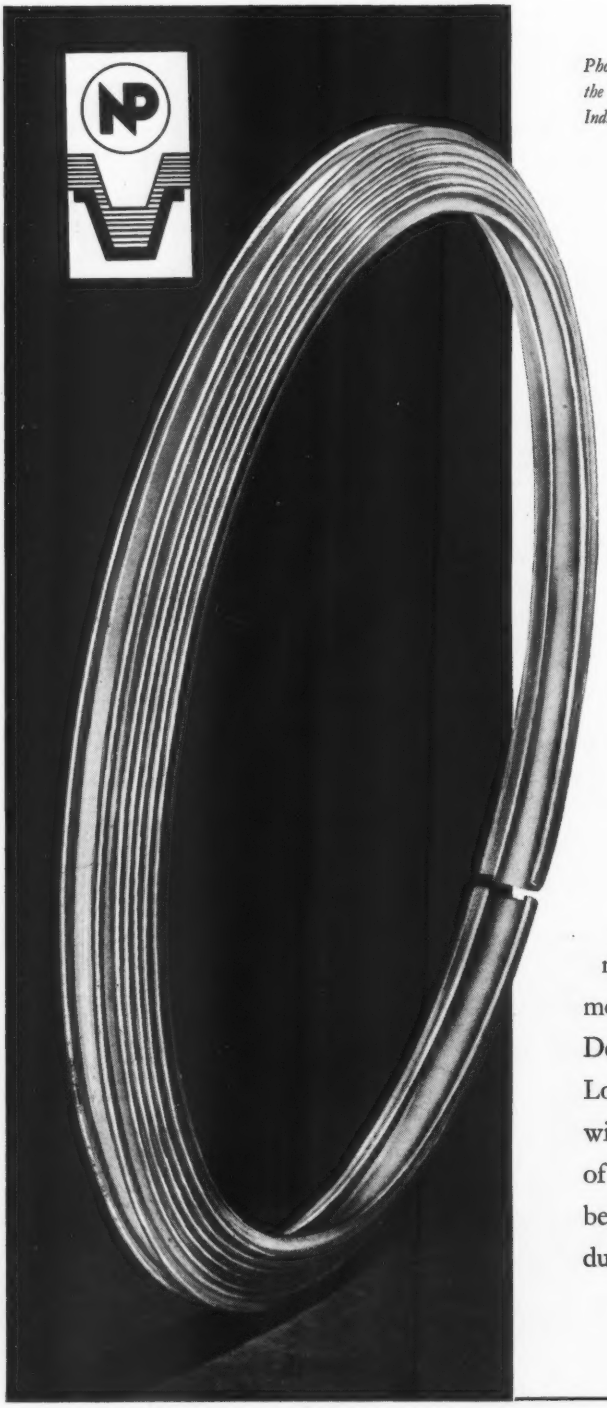

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Plastics

VOL. XVIII. No. 188 MARCH, 1953

EDITORIALS

Productivity Team Report

THE report of the plastics moulding team that went out to the United States a year ago has now been published by the British Productivity Council and although to many it seems to have taken an unconscionable time being born, it has been worthwhile waiting for.

The whole is a well-knit effort and as we relate on other pages it portrays the technical scene, which each of the team primarily went to see since it affects all so much in their working life. In six short weeks they saw some of the finest of the American factories and came back with a pretty good understanding of American methods and much of real practical value for the authorities that sent them out. In the same six weeks they also enjoyed the general American scene—the life that exists away from the works.

But when all is said and done, it is one thing to understand a situation but it is another thing to do something about it. Under a special section entitled "Conclusions and Recommendations" the report details many points, most of which are technical and others which are not; some or all might prove applicable here. We wonder what will be done?

Broadly speaking, the simplest part of the whole visit to understand and to report on was the detailed technical side, because all the members of the team were technologists, and our best ones at that. They did not walk round the American factories, open-mouthed and starry-eyed as a dusky gentleman straight from Central Africa might do. Our team, as they frankly admit, found many useful ways and means of pure technical improvement and have tabulated them carefully for us to digest, but taken all in all, there is little to choose between a factory there and a factory here from the purely engineering point of view.

No, we regard the most important part of the report (which, unfortunately and inevitably, is but a small part of the whole) to be that which deals with the American scene of life outside the factory. And we wish the same members could go out again for another six weeks without visiting a single factory, to understand even better the spirit behind it all, for it explains much of the reason for high American productivity. Machines as machines and gadgets as gadgets, do not. It might have been worthwhile presenting each member with a copy of an American history book.

Politicians, we note, are fond of talking of Americans and the British as possessing the same ways of life. They are talking nonsense, unless they are referring only to the moral concepts—to the Four Freedoms, if you wish. But the way of real practical living and working for that living differs vastly in the two countries, as differently as each lives from the Frenchman or German. If this were not so there would be no need for any Productivity Council at all.

What we have to decide between are things, spirits and emotions so traditional to, and ingrained in, each country that one is almost fearful about tackling them—so slow must any change be.

Without being critical of the Americans or ourselves except on occasion, we may mention a few of the differences we ourselves noted during a stay of nearly five years in the Americas a longish time ago.

Because of his history the American is much more loose-footed than the Briton in this country and in general is quite prepared to give his boss "the sack" or receive "the sack" without batting an eyelid, and to shift his location often over long distances to an extent undreamed of here, where the static job is the most desired and where long service is a fetish. Both aspects are traditional, the former adventurous, not very comfortable, but certainly virile, the latter the result mainly of craft organization.

The American worker saves very little of his money, about half that of his opposite number here. We note that the report states that the average American is not concerned with money in terms of dollars but only in the goods and services which money can bring him. This is a silly way of talking since the Briton puts money in the bank for the very same reason—not to hoard it for ever, but to buy outright a house which needs a lot of money or to save it against a rainy day, a process which every private or public company here or in the U.S.A. adopts as a wise course. The American spends most of his money because he likes to do so and believes, as Steve Brody did when he dived off Brooklyn Bridge, in taking a chance. Because of his history the American considers as essentials many things that we do not. On the other hand, our changing life here has now convinced us that washing machines and refrigerators are true essentials. To us, a motorcar (other than to businessmen) is not an essential because there are no really great distances to travel for our holidays and there is not much pleasure in travelling in a very small country in company with a couple of million other cars. Many Americans consider television essential; we do not, but we can amuse ourselves and educate ourselves more easily than the Americans can. In passing, part of the reason behind changing his automobile every two or three years is, often quite deliberately, to keep other Americans busy.

We take pride in some of our machines being old (we know two beam engines still working in the country which the directors stroke affectionately every morning). Americans use machines as machines to save human labour quite deliberately. We install new machines because they are of the latest type rather than for their reaction on labour.

These are some very few of the differences that exist in spirit between the two nations, and we are not quite sure that we ought to attempt to emulate or imitate the Americans in any sense.

Except in one! And this one, we are delighted to note, the report stresses especially. The American worker is made to feel the importance of his job in relation to living, and reciprocates; even the top jobs are really open to him. If we solve this one problem only, we have done the most important job of the lot.

We note with grim amusement that the team reports that certain English companies refused it admittance before its departure to the United States. We might add that this was not uncommon in the United States twenty years ago. But they learned more quickly there that factories that shut their doors also shut out new ideas and have to pay through the nose for those ideas later. For our part, we thank the team and, of course, the British Productivity Council. The report is a breath of fresh air in what is often a stuffy world.

Polymers Under High Energy Radiation

DURING the past few years an interesting series of tests on the effect of high energy radiation on long chain polymers has been carried out at the Atomic Energy Research Establishment at Harwell. Some of the work has been reported in detail recently in the Proceedings of the Royal Society and some general notes have been published by Dr. A. Charlesby in " Nature."

The most interesting result that has emerged from these experiments is the fact that when subjected to high-energy radiation such as is given in the B.E.P.O. pile, a number of polymers such as polythene, polystyrene, " Terylene " and nylon, become cross-linked, the degree of cross-linkage being proportional to the radiation dose. In other words, these polymers become more rigid, harder and less thermoplastic with increase in radiation dosage.

Above a certain short radiation dose corresponding to two cross-linkages per molecule, polythene becomes insoluble in organic solvents and no longer melts, even at temperatures considerably above 120 degrees C. After considerable exposure to radiation, polythene becomes completely amorphous, hard and glass-like. Impact strength decreases with increase of cross-linkage.

As for polystyrene, higher radiation doses are needed to give cross-linkage and the material becomes insoluble in organic solvents. Impact strength is not diminished.

While Dr. Charlesby hints that the commercial applications of the process of radiation dosage to polymers might prove interesting, it is difficult for outsiders to imagine, in view of the costs, that this would ever be so.

It is exciting to be able to carry out cross-linking by a non-chemical method and to confirm the work of the past 30 years that it brings rigidity and insolubility in its train. Clearly we are here performing a controlled " tailoring " or ordering of the molecule, and obviously it would be important to have our polythene rigid, hard and unaffected by high temperature and solvents when we require such properties. Obviously too, we could make wider use of a polystyrene that is insoluble in benzene, which normal polystyrene is not. On the other hand, we do not wish to lose the very useful high impact strength of polythene, nor, since some surface oxidation takes place during radiation, do we want a change for the worse of its dielectrical properties. Further data regarding the extent of such changes are awaited with interest.

MOULDING POWDER AND SHOT

A short while ago I was shown some of the most pleasing and prettiest mouldings I have ever seen in my life and since no technical production has ever been called " pretty " you will guess the mouldings were toys. They were in fact tiny reproductions of the characters in "Alice in Wonderland," replicas of Tenniel's delightful drawings of Lewis Carroll's story—so enchanting and so beautifully made and painted that I'm sure both author and artist would have approved. I am told that the figures are American productions and I am not surprised at all, for some of the U.S.A. toy-makers seem to specialize in toys with the human touch far more than we do. We're pretty hot on the heavy " mechanical " type and certainly do well with dolls. But we don't seem to use our imaginations very much although we have a rich literature and history to draw upon, and a great tradition in porcelain and china production that could be duplicated in beautiful unbreakable toys. Unlike our porcelain industry and unlike the Americans, our toy-makers do not like employing artists to help them, nor do we like tackling the problem of training new workers in the art of painting delicately. The job is worth while approaching, for the toys I am talking about will thrill the young and the not so young—they could almost be classified as " collectors pieces." Why can't we ourselves tackle Dickens's unending stream of characters known in almost every country on the globe, or R.L.S.'s heroes and villains, to say nothing of the other international fantasies that live for ever, from Rumpelstiltskin to the Three Musketeers? Much more intelligent than moulding pistols: given the designs, our mould makers and moulders would meet the challenge.

Queen of Hearts

* * *

Business seems to have improved quite appreciably in several branches of the industry and polystyrene, especially certain grades of it, is again in good demand. What appears to be an even better indication of the situation is the basic fact that mould makers' deliveries are very well forward; in fact, some cannot promise them under six months, which is bothering many moulders who are so anxious to get going and use their presses full out—a condition that was far from general during 1952. Some are blaming the mould-makers for doing work for the Americans. I cannot for the life of me understand why they should be blamed even if it were true, but I am assured that while requests from the U.S.A. have been received, most of them have not crystallized owing to long delivery periods. No, it seems that the bulk of the work is for the home trade.

Things Looking Up ?

* * *

While in a moulding shop recently I was watching small injection mouldings being dropped into a tank of water for cooling and as I saw them piling up on the bottom it struck me that on occasion some could be distorted permanently white hot by the mere weight of superimposed mouldings. If this matter is of importance I think it could be avoided by one of the simple elementary tricks sometimes used in the laboratory for estimating specific gravities, namely to increase the specific gravity of water so that objects in it just float below the surface. For mouldings heavier than water, glycerine, sugar or various salts may be added to obtain the result required. Polythene mouldings of course float on water and it would be necessary to reduce the specific gravity of the water to make the mouldings descend below the surface. This can be done by adding methylated spirits to the water.

Let Them Float !

* * *

Cellulose acetate certainly wants a " lift-up " and it will not be the fault of the London Association of Dispensing Opticians if an improvement does not take place during Coronation year. According to the " Evening Standard " night reporting corps (!), one of the speakers at a recent meeting of the Association, Mrs. Lilian Whitaker, " a slim elegant blonde who does not wear spectacles ", told her audience that " the minimum spectacle wardrobe is three pairs . . . but I know of one American dowager with 84 pairs, one debutante with 20 and an Italian countess who has a pair to match every room in her house, most of her dresses and one pair to match her bedroom sheets—in peach." Shape hints from Mrs. Whitaker: For the short face, a shallow shape; for the long face, medium upswept with depth; for a long nose, a low bridge; and for a receding chin, spectacles which are not too prominent. Well, after that the opticians should have a lovely Coronation year and to make certain they might try trading " the elegant blonde who doesn't wear spectacles " for a swarm of American dowagers or a gaggle of Italian countesses.

The Best People Wear . . .

DOGSBODDY.

Designs for the new coins *(Photos: Crown Copyright)*

Welded Packs for New Coins

FOR the occasion of the Coronation the Royal Mint will be issuing at least one million complete sets of the coins of the new reign. These sets, which will be distributed through the banks, will be packed in "envelopes" made from clear transparent polyvinyl-chloride sheeting.

The material which was chosen for the coin packs was semi-rigid plate-polished p.v.c. sheet, 0.008 in. thick, manufactured by Messrs. Stanley Smith and Co., of Worple Road, Isleworth, Middlesex.

The supply of the welded packs ready for subsequent filling and closing at the Royal Mint was undertaken by Radio Heaters Ltd., of Wokingham.

The design of the pack can be seen in Figure 6. To assist distribution, the packs are manufactured in pairs welded side by side. The coins are placed in three rows holding three pieces each. The smallest row contains a ½d., a 3d. piece, and a 6d. The centre row contains an English and a Scottish 1s., and a 1d. piece, and a third compartment taking a half-crown, a ¼d. and a florin. Embossed on the corner of each pack are the names of the designers of the new coinage. The double pack can be divided into two single packs by tearing down the centre of the double pack, which is perforated for this purpose.

The transparent p.v.c. material is received in sheets size 54 in. by 24 in. Stacks of 20 sheets are cut by means of heavy-type forged-steel cutting knives and a conventional cutting press. The welding of the packs has presented several technical problems. Owing to the fact that a semi-rigid p.v.c. sheeting is used, a far greater accuracy in the manufacture and maintenance of the welding electrodes is necessary than would have been the case if a softer grade of p.v.c. sheeting had been employed. It was also found that it was desirable that the embossing of the wording referring to the coin designers, etc., should be a second distinct operation rather than to attempt to combine the embossing with the main welding. It was found that when the embossing and welding were combined in a single die, inconsistent results could be produced due to extremely small fluctuations in the thickness of the sheeting over the size of a single pack. The welding is therefore broken down into two stages. The first weld consists of the frame-work which divides the pack into the different coin compartments. For this operation a Radyne Model P.W.10 pneumatically operated welder is employed. This machine is specially tooled for fast operation by two operators. Stacks of the pre-cut sheets are placed before the operator. A pair of patterns are placed in a special loading tray, the metal base of which is machined perfectly flat and serves as the lower electrode for the welding operation. This tray or jig then slides into position and the top electrode, which carries the design of the welding lines, is brought down by means of a foot-operated pneumatic air-switch. The welding cycle comes on automatically as soon as the electrode has come down on to the patterns. A red pilot light indicates that the high-frequency power is on. At the completion of the automatic welding cycle this light goes off, the ram is raised, and the operator slides the second welding jig into place. One operator can remove the welded pack and re-load the first jig while the other operator is engaged in welding the second pair of patterns in the second jig. The total length of

Fig. 1.—Guillotine cutter on a hand-operated press stamping out sheets of transparent p.v.c. for the coin packs. A spare cutting tool is seen in the foreground.

Fig. 2.—A general view of the Radyne P.W.10 welder showing the top electrode in a raised position with one loading jig in the welding position and the other (right) loaded. The pilot-light on the front of the welding head, lights up only while power is on.

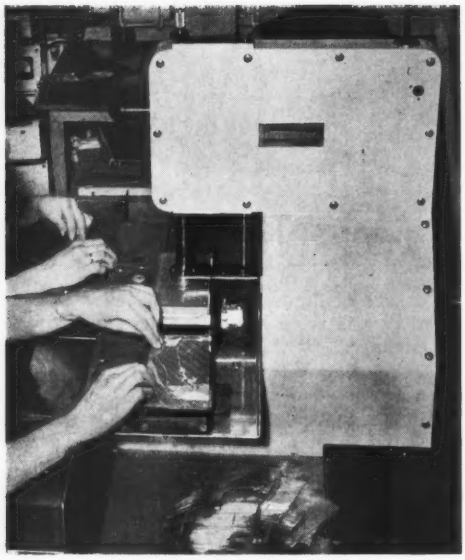


Fig. 3.—Pre-cut sheets being loaded into one welding jig whilst the other jig is under the welder.

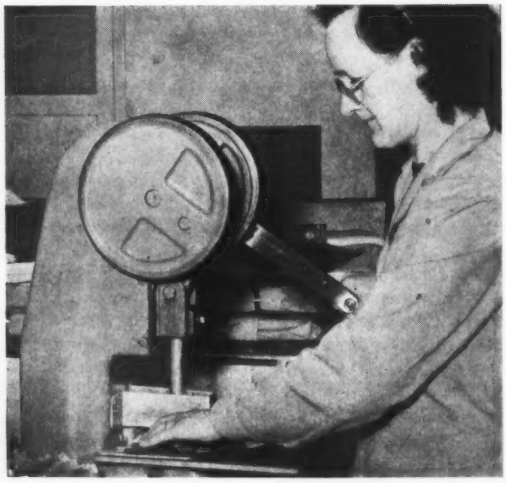


Fig. 5.—A toggle press fitted with a special knife perforates the double pack for easy separation.

Fig. 4.—The second welding operation, performed on Radyne W5/B machines with a straight bar electrode, embosses wording on the packs. Although the machine is normally pedal operated, a hand lever is used to exert extra pressure on the top electrode.

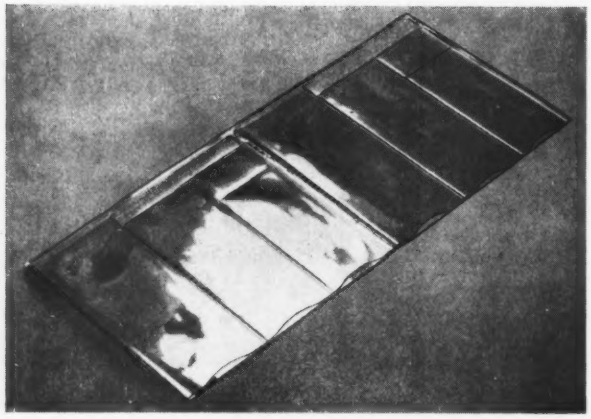
the welding lines on the double pack is about 36 in. with a weld width of approximately $\frac{1}{16}$ in. The average output from one such machine is eight double packs per minute.

The second welding operation consists of simultaneously embossing the message in the corner of each of the single packs. This operation is carried out on the Radyne Model W5/B-type welder fitted with a suitable locating frame so that the double pack can be correctly registered for the embossing. This operation does not introduce any great difficulty, except that as before the nature of the semi-rigid sheeting employed demands a very high degree of accuracy of manufacture of the special double embossing die employed.

After the embossing operation, all that remains is to cut a series of perforations across the centre of the double pack so that the single packs can subsequently be parted as and when required. The perforation is performed by means of a cutting knife attached to a small toggle-acting press.

The empty double packs are packed and dispatched to the Royal Mint in suitable-sized cardboard cartons which can subsequently be re-used for transmission of the filled packs to the banks, etc.

At the Royal Mint the sets of coins are loaded into the packs and the packs finally closed by means of Radyne Model W5/B-type welders fitted with special combined straight-bar electrodes and locating frames.



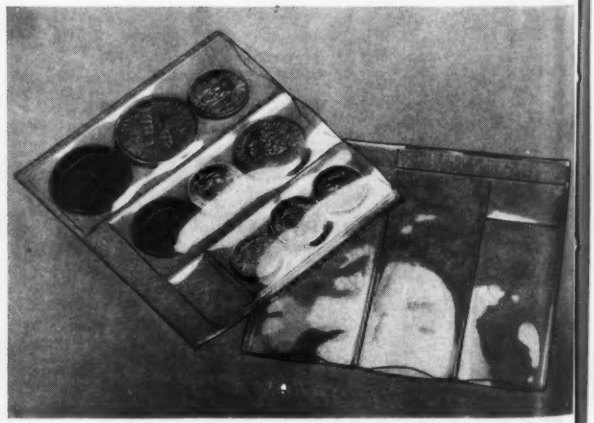


Fig. 6 (Left).—The complete double pack as it leaves the fabricator; (right) the pack has been separated and some current coinage has been inserted to show how the pack will be loaded before sealing at the Royal Mint.

Productivity Team Report—Plastics Moulding

On February 12, 1952, a Team left Southampton to study plastics moulding in the United States. Organized by the British Productivity Council, the team was selected by the British Plastics Federation, the Engineering and Allied Employers National Federation and the Confederation of Shipbuilding and Engineering Unions. We publish herewith some of the interesting points arising out of the conference at which the Team met the Press, held at the offices of the British Productivity Council, London, S.W.1, on February 13 last.

"EMPLOYER and employee in the U.S.A. look to the future and have great faith in it." This was the keynote of most of the replies to purely non-technical questions which were put to Mr. Sparshott, the leader, and to others of the team of technologists who returned from their visit impressed with the basic spirit that permeates American industry and which appears to have such startling results on American production and the American way of life.

One facet of American life which most impressed the Team was the atmosphere of unity of purpose which existed in factories throughout the length and breadth of the country. They found that the employee feels, and is encouraged to feel, that his future is closely linked with that of his company, and even the top jobs are open to him. This feeling engenders a sense of responsibility towards his job only rarely encountered in Britain, and it was partly to this fact that the Team attributed the degree of productivity which is to be found in the U.S.A. This spirit of co-operation permits changes to be effected within the organization of the company which would probably, in this country, give rise to local industrial unrest. Improvements in methods and greater mechanization are accepted by employees willingly because they feel that the more efficient is their plant the more they stand to gain as individuals both now and in the future. They are collectively conscious of the vast markets that exist within the United States, markets that are capable of absorbing the greater production that is consequent upon improved methods without staff dismissals.

This sense of responsibility towards his job and his employer is contrasted by a deep-seated faith in the future of American industry which permits the employee to live on a scale far higher than his opposite number in Britain, even including the relatively higher wages that he receives. One of the Team reported that reliable estimates in the U.S. compute the number of cars paid for cash down at not more than 10 per cent. of the total produced. Indeed many cars are never bought at all in the sense that before the end of their working life and before the instalments are fully paid, they are traded in for the newer model. This apparently is a feature of American life as a whole and embraces not only motorcars, but other domestic utilities such as washing machines, refrigerators, and television sets. It was obvious that the Team had been greatly impressed by this aspect of American life and it was further obvious that they attributed to it much of America's greater productive effort. The atmosphere in which employer arrives at the factory at the same time as his employee, each addressing the other by his Christian name, eating together in the same canteen and frequently side by side, is one that promotes a team spirit invaluable to an expanding industry and is given special mention in the Productivity Team's report.

In introducing the report to the Press, the leader of the Team highlighted some of the findings which surprised the Team itself. The size of concerns engaged in the U.S. moulding industry was smaller than was anticipated, only one per cent. employing 500 and over. The highest group, 28 per cent., comprises companies employing between 100 and 199 people. On this score therefore the American moulding industry bears a distinct resemblance to that of Great Britain. Furthermore, the size of contracts commonly encountered was not significantly greater than those that were obtained in this country. In terms of size and contracts, therefore, the two industries are very similar. These two facts only serve to emphasize the difference between the two countries in terms of productivity, particularly when it is pointed out that the American moulded unit is frequently cheaper than its counterpart in Britain in terms of £s sterling.

THE TEAM

Front Row: J. H. P. White, E. Patching, J. J. Capece (U.S.), W. C. Fish, E. L. Merritt (Deputy Leader), L. Honey. *Second Row:* R. Norwood, J. S. Walker, A. L. Sparshott (Leader), D. Eccles. *Third Row:* H. Beaumont, C. J. G. Stanley (Secretary). *Back Row:* J. R. Tegerdine, E. H. Sharp, F. A. Howlett, J. Barker, A. Prasser.

A powerful force accounting partly for the rapid expansion of the plastics industry in the U.S. is the clever publicity distributed by the materials manufacturers. This has had the effect of plastics materials being accepted by the American man-in-the-street as materials having quite separate identities and well worthy of use in many applications in their own right. This attitude of mind cannot help but make for increased sales, and it is to be hoped that a similar situation will develop in this country where, only too frequently, plastics are regarded by the potential consumer as a substitute for something else which, had it been used, would have given a better product. According to the Team, American mouldings are not sold because of higher standards of finish than in this country; on the contrary, production costs are kept to the minimum by severe limitations on post-moulding operations. As an example, flash lines are frequently routed out rather than buffed. The American argues "why try and disguise a feature of moulding that is inherent to the process itself and that is incapable of complete elimination?" This argues that the American public has been conditioned to accept mouldings at their face value, as functional units and as being produced at the lowest possible cost commensurate with their capability of performing the function required.

The Report

The team left Southampton on February 12, 1952. The selection of members had been the responsibility of a joint committee of the British Plastics Federation, the Engineering and Allied Employers' National Federation and the Confederation of Shipbuilding and Engineering Unions.

The terms of reference for the Team are summarized as follows:—

"To investigate the rate of productivity attained in the American Plastics Moulding Industry and to observe all factors bearing directly or indirectly thereupon. Such factors will include:—

"(1) Management policies, sales and distribution, public relations, industrial relations, plant layout and equipment, and equipment maintenance;

"(2) Development in mould and tool design and in mould fixtures;

"(3) Design and operation of moulding machines, particularly in regard to the development of automatic, semi-automatic and cycle-controlled mechanism in the compression moulding field;

"(4) Development of machines of large shot capacity and mould area and of methods of pre-plasticizing and feeding of material in the injection moulding field;

"(5) Comparison of lifts per hour and shots per minute;

"(6) Specialized handling of the newer thermoplastic materials and of melamine;

"(7) Tooling equipment for finishing;

"(8) Marketing, costing and new applications;

"(9) Percentage press operation and the percentage of hours worked and the basis of operation."

Divided into three groups, the Team was able to obtain information on all points of interest without undue overlapping and consequent wasted effort. Each group divided the work among its members and chose its leader in its own way. The organization and specific terms of reference for each of the three groups is as follows:—

Organization Group: J. Barker, H. Beaumont, E. L. Merritt, R. Norwood, J. R. Tegerdine. Terms of reference—Industrial relations and welfare, public relations, plant layout and equipment, management policies, markets, sales and distribution, costing.

Thermosetting Group: W. C. Fish, L. F. Honey, E. Patching, A. L. Sparshott, J. H. P. White. Terms of reference—Development in mould and tool design and in mould fixtures. Design and operation of moulding machines, with particular reference to automatic, semi-automatic and cycle-controlled mechanisms. New developments in materials and techniques of moulding, including melamine. Finishing equipment and methods, assembly and packing. Percentage press operation and percentage of hours worked.

Thermoplastic Group: D. Eccles, F. A. Howlett, A. Prasser, E. H. Sharp, J. S. Walker. Terms of reference—Development in mould and tool design, and ancillary equipment, with particular reference to automatic stripping and de-gating. Design and operation of machines, with particular reference to automatic machines, large machines and pre-plasticizing. Specialized handling of the newer thermoplastic materials. Finishing, assembly and packing. New materials, production techniques and applications, including nylon. Regrinding, pre-drying and dry-colouring of materials. Stress removal and annealing. Percentage press operation and percentage of hours worked.

The Team secretary was C. J. G. Stanley.

The usual arrangement when visiting factories was for the Team to be met by a senior executive of the company concerned, for a brief talk. After this, the Team split up into parties and toured the works, followed by division into its three groups for detailed discussion with appropriate members of the company, the visit concluding with a general discussion between the whole Team and a large number of representatives of the company.

This routine would, however, have been insufficient to give the Team a detailed insight into American productivity. It was essential for the members to get the feel of the character of the nation as a whole and many discussions, both formal and informal, took place during the visit and during both voyages. By piecing together the personal experiences of individual members of each part of the team it was possible to build up a comprehensive picture of the American scene. Chapter 2 is devoted to a composite of the individual members' impressions and provides a valuable insight into the American way of life. The comparative figures for cost of living are particularly interesting.

In Chapter 3 considerable attention is devoted to the relationships of union and management. Attention is drawn to the absence in the U.S. of a single central body equivalent to the Trades Union Congress in Great Britain. It is estimated by the Society of the Plastics Industry that 48 per cent. of the workers in the plastics industry in America are organized, which is believed to be rather more than in Britain. The moulding industry is apparently not organized on a national scale; instead a number of unions compete for control of individual factories, each union considering that the industry should come under its jurisdiction. It is a fact that any union in the U.S. can, with the support of the employees, become the negotiating body for any particular factory which constitutes the essential difference in union organization between the U.S. and Britain.

The "closed shop", a factory where the union is so far in control that a new employee must join the union before starting work, has been banned under Federal Law. In its place is the "union shop" where the new employee is required to join the appropriate union after a specified time. When a worker leaves a job he automatically leaves the union but he will rejoin it, or join another one appropriate to the factory where he takes his next job.

Contracts which are renewed periodically are always on a plant or factory basis and are reproduced in booklet form for issue to each employee. The Team feels that negotiations leading to contracts at factory level are a very successful arrangement, and materially assist in promoting close relations between management and labour. Chapter 3 quotes an extract from one of the contracts seen by the Team.

Chapter 4, dealing with wages, incentives, and working conditions, gives a very detailed picture of American conditions. In all factories visited the moulding shops were working three shifts, giving a 40-hour week, with differences in rates of pay per shift as follows: Shift 1, 7 a.m.-3 p.m. at the basic rate of pay; Shift 2, 3 p.m.-11 p.m. with a bonus of 5 per cent.; Shift 3, 11 p.m.-7 a.m. with a bonus of 10 per cent. Women are often employed on the night shift except in those States where it is illegal. This chapter includes a table showing the average earnings in the industry under varying job classifications.

Incentives include superannuation and profit-sharing schemes, rewards for suggestions, paid meal breaks, and paid annual holidays governed by length of service.

Safety is approached in a different way from that obtaining in Britain. Monthly safety meetings are held, safety first posters are placed in prominent positions and the worker is encouraged to protect himself. This gives rise to conditions which would cause a factory inspector in Britain to close down a factory, but the Team notes the very low accident rate statistics displayed at many of the factories visited.

Estimating, costing, planning and sales are dealt with in Chapter 5, the introduction to which is particularly interesting by virtue of its comments on the American public's ready acceptance of plastics materials. It was noted that the size of moulding concerns in the U.S. are not large by comparison with those in Britain.

The Team found that executives are very "cost conscious" and that time study experts are more widely employed in the United States than in Britain to fix piece-work prices or to establish hourly rates of production.

Chapter 6 constitutes a detailed technical examination of American techniques in thermoplastic moulding. The Team comments that the consumer of thermoplastic materials in the U.S. is fortunate in having a wide choice of suppliers with an abundancy of standard materials. Materials suppliers themselves go to great lengths to advise the consumer, particularly where special grades of materials are required to satisfy certain specifications.

Dry colouring of polystyrene is widely practised although one company stated that it was necessary to have laboratory conditions of mixing control to overcome the difficulty experienced in the exact matching of batch colours.

The use of pre-heating and drying is greater than in Britain, the object being mainly to reduce the moulding cycle. In some cases, however, it is also claimed that improved quality and more accurate reproduction results. Notes are included on the various methods of pre-heating and drying that are employed.

Pre-plasticizing, necessary because of the abnormally heavy sections and large area mouldings that are produced from standard machines, was a feature of several factories visited by the Team. Machines for this purpose are illustrated in this chapter by line drawings coupled with very useful commentaries in the text.

The Team noticed a tendency for individual moulders to modify standard machines and seven of the major alterations that have been effected are scheduled in this chapter.

In the field of large machines, a table is quoted showing the increases in the size of machines since 1937. It is estimated that some seven machines of a capacity of 200 oz. each are actually in operation in moulding shops in the U.S. and four machines having a 300 oz. capacity.

Although the Team did not see any fully automatic injection moulding machines in operation, they were able to establish that they do exist. From conversations held with various manufacturers the Team was able to compile a list of six essential points covering the satisfactory operation of automatic injection presses.

In the field of injection mould design, no great difference was found between American and British practice. However, the Team felt that it had benefited from its study of American techniques and that probably were American mould designers to visit some factories in Britain they would benefit in a similar manner.

Of particular interest in this chapter are the many line drawings used to illustrate interesting techniques noted by the Team in the tour. The chapter is also very well illustrated by photographs.

Equally well treated is Chapter 7 dealing with thermosetting moulding. The Team had expected to see highly mechanized and up-to-date plants of the type associated with American methods of mass production. In was found, however, that in this field American industry is remarkably similar to that in Britain and with substantially the same type of equipment. In general the equipment is older than in Britain.

The higher rate of production attained in the U.S. is held to be a combination of many features and Chapter 7 sets out in detail the methods employed by this section of the American industry. It is interesting to note that the average overall loss of material as a result of flash, faulty moulds, etc., is estimated at 15 per cent.

The heating of moulds was approximately 98 per cent. by steam using equipment similar to that employed in British factories. Pre-heating methods included normal steel coil heating but moulding engineers in America are unanimous in considering H.F. pre-heating the best method. Curing time is generally between 25-33 per cent. less than in Britain. The chapter gives detailed information on insert techniques, cure, transfer moulding, automatic moulding, new materials, etc., and is well illustrated with photographs and line drawings.

On the subject of finish and inspection, the Team has much to say. It found that the American consumer will frequently relinquish refinements of finish in favour of lower cost, the controlling factor being the ability of the moulding or the assembly of mouldings to perform the functions allotted to it. This factor permits severe limitations to be placed on post-moulding techniques with commensurate saving in cost.

The chapter discusses the standard methods of finishing employed, similar to those used in Britain. The tendency is to mechanize such processes where possible. Particular attention is drawn to the Wheelabrator Tumblast, manufactured by the American Wheelabrator and Equipment Corporation, which has been adapted to de-flashing techniques.

Chapter 10 contains the conclusions and recommendations. We publish below, by permission of the British Productivity Council, a summary of the recommendations of the Team. It is obvious that the report has been very carefully thought out and is the end product of very hard work on the part of all members of the Team. In its pages every person connected with the plastics industry in Britain will find something of interest to him and the report as a whole should rank as one of the most important contributions to the literature on plastics in recent years.

Recommendations of the Team

1. Training and employment of more specialists in engineering and design and in liaison work within this field. Less emphasis upon greater physical effort by the worker, and more emphasis upon positive improvement of methods. Far more careful and detailed engineering of each job and increased mechanization wherever possible.
2. More intensive effort by management to convince the worker that he shares in the fortunes of the company, and an effort by the worker to take a greater interest in the affairs of his company, to their mutual advantage.
3. Improvement of the general standard of efficiency by a greater interchange of factory visits within the industry, with emphasis on a real exchange of ideas at all levels.
4. Reorganization of industrial relations to promote a more rapid settlement of disputes.
5. Product designers should be encouraged to co-operate fully with the moulder in the development stage of their work.
6. Education of the consumer to accept a realistic standard as the criterion for inspection in relation to the cost of the product.
7. Appreciation that the highest efficiency can be achieved only by greater specialization of companies on particular products and types of production within one factory.
8. Greatly increased use of informative advertising.
9. Increased use of shift working, and consideration of the possibility of staggered meal breaks as a means of ensuring more continuous operation of plant.
10. Greater use by moulders of the technical services available from the material manufacturers, and the improvement of these services.
11. Increased use of motion study in the industry.
12. Use of standard bolsters.
13. Improvement of compression and transfer moulding techniques, with particular reference to the following:—
    - (i) Further study of methods of testing flow.
    - (ii) Use of shaped pellets and larger pellets, with the object of using one pellet to each impression.
    - (iii) Greater use of pelleting.
    - (iv) Greater use of H.F. pre-heating, and the study of higher frequencies and powers in H.F. heaters.

(*Continued on page 77*)

A New Application of Plastics to Printing

"MAKE-READY" is a term used in the printing industry identifying a particular part of the work that has to be carried out before the presses can be set in motion for any particular run. Broadly speaking this consists of preparing the cylinder of the printing machine in order to obtain the best possible results from the type or blocks to be printed. As will be seen from Fig. 1 the forme consisting of type and blocks is placed on the bed of the machine which then passes under the impression cylinder which is revolving at the same speed as the bed and which carries the sheet of paper to be printed. Theoretically if the machine bed, cylinder, and printing blocks are in perfect condition the printed result should be perfect. In fact considerable work has to be done before satisfactory printing is obtained.

It will be helpful to explain that for most photographic reproduction the half-tone process is used which consists essentially of a metal surface comprising hundreds of raised dots. The dots are largest where the photograph is darkest. Where medium or light tones occur that part of the half-tone block will have dots of smaller diameter. This means in fact. that the maximum ink is picked up where the dots are largest, which in turn gives the densest image on the paper.

To obtain the best possible print an overlay is prepared, formerly cut out by hand from several thicknesses of paper so that the heaviest portions of the block receive most pressure from the impression cylinder. This is placed on the cylinder in a position where it will register exactly with the block passing under it.

This whole process is embraced by the term "make-ready" and it will be seen that in high clarity printing the process can take some considerable time. For a whole page reproduction in *Plastics*, for example, a "make-ready" expert might be working for over an hour before he had built up the pull to the correct graduations in height.

An alternative method, known as the Primaton Process, originating in Switzerland, is now being employed in the printing department of Temple Press Ltd.

Fig. 2.—Virgin pull or "proof."

First a pull is taken from the required block on a hard surface paper using a specially tacky ink (Fig. 2). The pull is then placed in a tray (Fig. 3) which contains a thermoplastic powder of the polystyrene type. Examined under a microscope, the grains of the powder are perfectly spherical. The powder is delivered in four grain sizes of which it is customary to use two only on each subject. The first powder is brushed over the pull with a wide, soft hair brush and as it is moved cross-wise and length-wise over the picture, naturally adheres to the dark tacky portions but remaining unattached to the light sections of the pull (Fig. 4).

A second and finer-grained powder is used in a similar manner which fills in

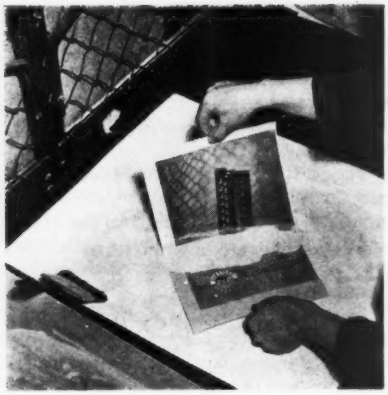
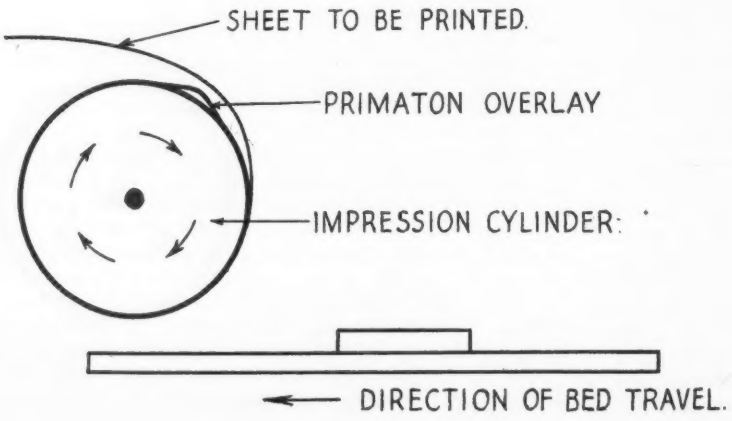


Fig. 3.—Tray containing powder, some of which is placed on the pull as shown.

the spaces between the larger grains and also clears away some of the larger grains adhering to the lighter portions of the pull. The pull thus prepared is then held over an electric heating element until the powder can be seen to have fused (Fig. 6).

The result is a hard relief surface of varying densities resulting from the fusing properties of the plastics material. Such

(Above) Fig. 4.—Brushing the powder across the pull to ensure its adherence to the tacky ink.



(Left) Fig. 1, showing the block placed on the bed of the machine. The block is inked before passing under the impression cylinder.

an overlay, as it is called, will not crumble or break up during printing and will permit very long printing runs (Fig. 7).

The effect of the operation is to raise the level of darker areas of the pull, the degree of thickness being graduated by the quantity of ink present on the pull, which in turn is governed by the size of the dots on the block itself.

Results so far would seem to indicate that this process effects considerable saving in time and at the same time actually improves the printed product. It is possible to achieve contrasts and clear prints which cannot be surpassed by any of the other known "make-ready" methods, since the varying thicknesses on the overlay are automatically directly related to the original block.

In conclusion, we should like to thank the works manager of Temple Press Ltd., Mr. S. R. Brown, who first brought this new process to our attention.

(Above) Fig. 7.

(Right) Fig. 6.—Pull being held over electric heating element.

PRODUCTIVITY TEAM REPORT (*Continued from page 75*)

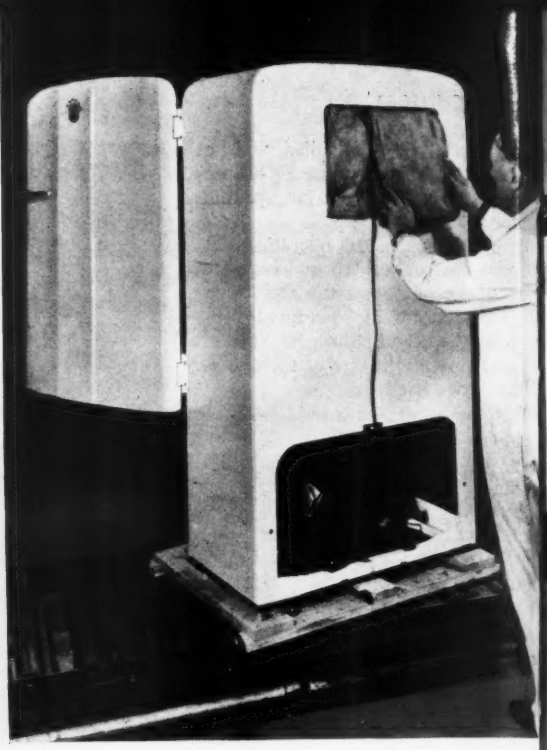
(v) More extensive use of automatic control of press cycles, including automatic core extraction.
(vi) Study of pressures, especially pressure ratios, in transfer moulding.
(vii) Use of fully-automatic presses where suitable.
(viii) Use of multi-tier moulds for melamine tableware and similar products.
(ix) Use of specialized finishing equipment, where justified by quantity and quality requirements.

14. Improvement of injection moulding techniques, with particular reference to the following points:—
(i) The standard general purpose injection moulding machine should be supplemented by special types to allow for short cycle, deep draw, automatic working, pre-plasticizing, etc.
(ii) Use of larger material cylinders of welded construction.
(iii) Fitting of multiple heater bands which should be removable and have improved contact with the cylinder.
(iv) Removal of timers to walls or adjacent stands, to eliminate the effect of vibration.
(v) Standardization of ancillary equipment such as solenoids, valves, etc.
(vi) Installation of armoured rubber piping in certain places to eliminate hydraulic hammer.
(vii) Temperature control of the oil.
(viii) Precision temperature control of the various parts of the mould, including the adoption of refrigeration where necessary, in order to ensure optimum moulding conditions.
(ix) Use of ball check nozzles for larger mouldings, to improve quality and reduce cycle time.
(x) Adoption of hot air units in the machine feed hoppers, and other methods of pre-heating at the press.
(xi) Greater use of three-plate moulds with built-in de-gating.
(xii) Increase in the practice of grinding sprues and scrap beside the machine for immediate re-use.
(xiii) Adoption and use of power-operated fixtures adjacent to moulding machines for de-gating and finishing.
(xiv) Use of the moving platen to open the machine guard.
(xv) Inclusion of nozzle torpedoes for improved colour dispersion, particularly when using dry coloured material.
(xvi) Restriction of the mould opening movement of the machine to the minimum required to extract mouldings.
(xvii) Use of water-cooled injection piston on the larger machines.
(xviii) Use of replaceable pyrometers with plug-in connections.
(xix) Automatic pre-positioning of the injection piston for shorter injection stroke.
(xx) Use of special attachments for varying the speed of stroke.
(xxi) Use of smaller and shorter sprues and feeds.
(xxii) Preventive maintenance, including oil cleaning, pump inspection and regular inspection of moving parts, toggles, valves, electrical gear, etc.; and regular performance tests.
(xxiii) Much greater attention to the balancing of gates.
(xxiv) Greater attention to the development of pre-plasticizing.
(xxv) Greater understanding of injection moulding principles by mould makers, to avoid unnecessary time lost in production shops in testing and proving.
(xxvi) Further study of new methods of mould manufacture, with particular reference to beryllium copper alloys.

PLASTICS
IN THE SERVICE OF MAN

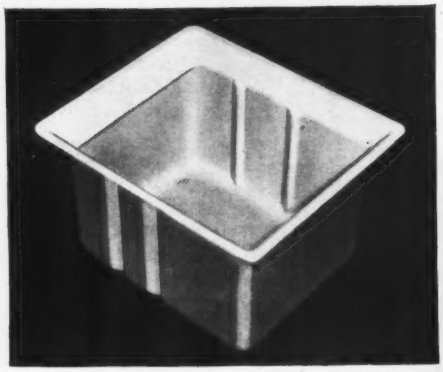
A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

37. Refrigeration—II

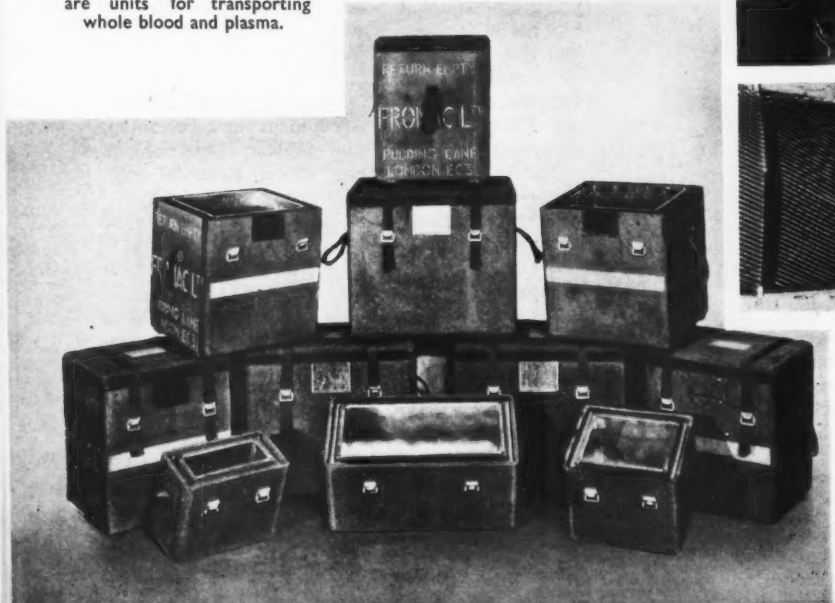


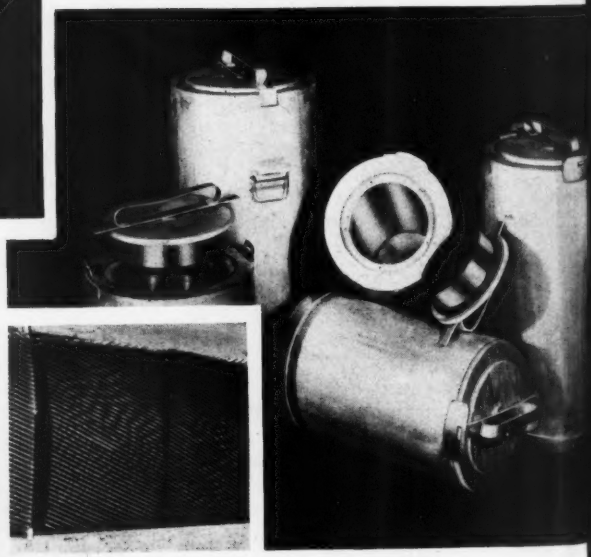
(Left) Inserting Fibreglass slabs, bonded with phenolic resin manufactured by Bakelite, Ltd., in the doors of refrigerators made by the Kelvinator Co., Ltd. (Above) Fibreglass slabs being packed into the back of a Kelvinator refrigerator to provide an insulating medium.

(Right) Refrigerator interior, manufactured by Ashdowns, Ltd., employing the deep draw technique. The material is rigid polyvinyl chloride.

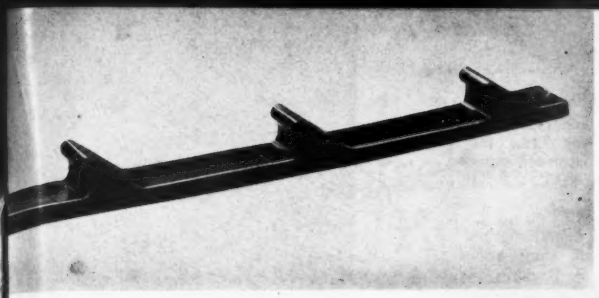


(Below) Lightweight insulated containers manufactured by Moulded Components (Jablo), Ltd., from Aero Jablex, an expanded plastic material. At the back are shown containers for frozen food, and at the front are units for transporting whole blood and plasma.



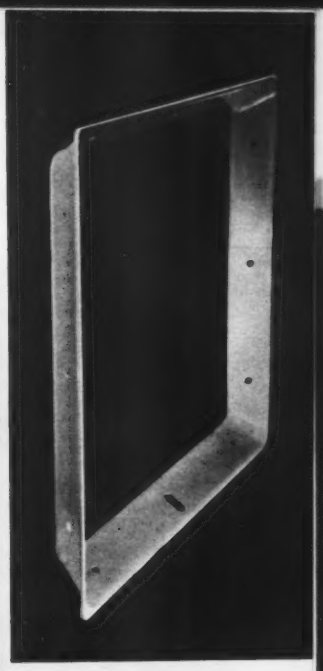


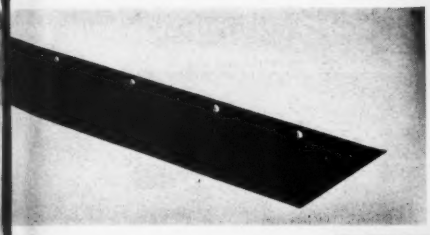
(Above, right) Ice cream shippers, manufactured by Zero-Pac of Poole, Dorset. Insulated with Isoflex, corrugated cellulose acetate (shown above, left), which is manufactured by B. X. Plastics, Ltd.



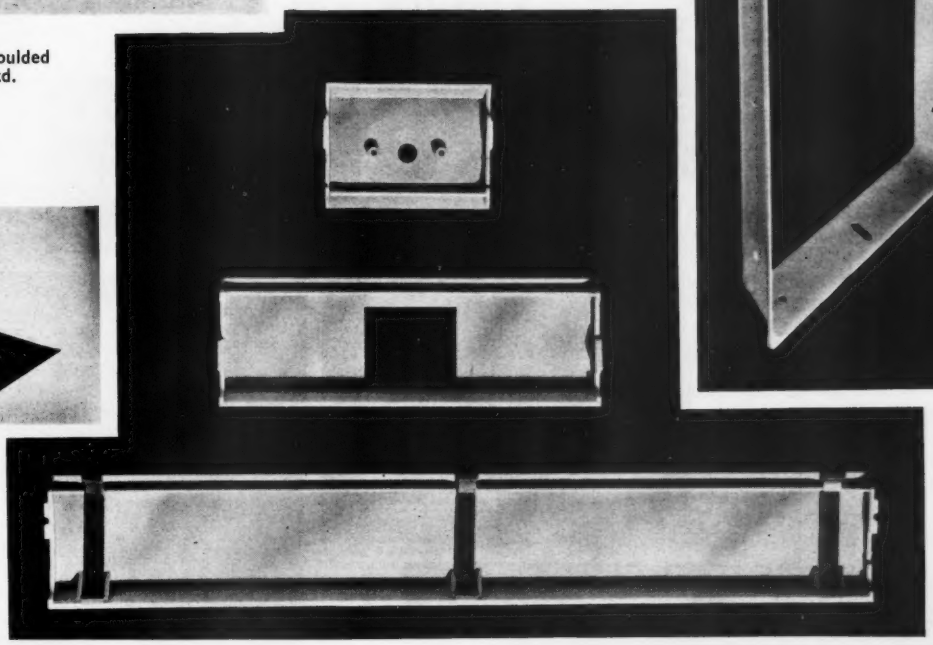
(Above) Refrigerator shelf support moulded in black phenolic by Ashdowns Ltd.

(Right) Frame for refrigerator, moulded by Ashdowns Ltd., from polystyrene.

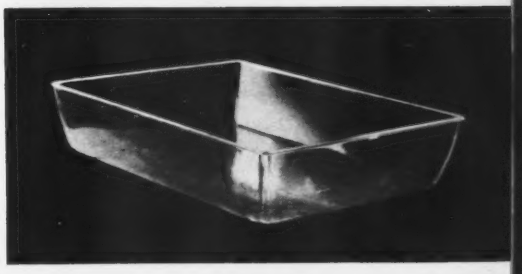




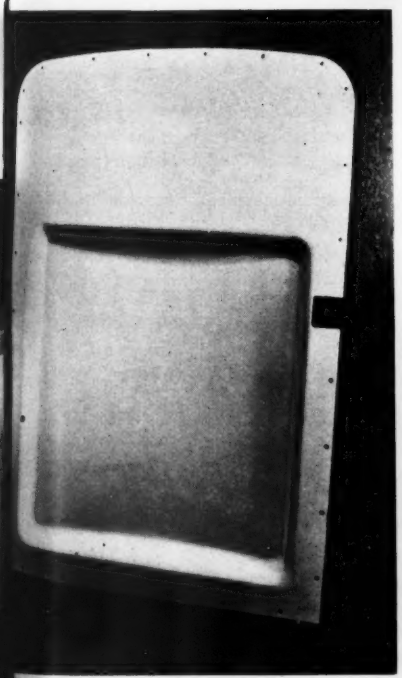
(Above) Breaker strip moulded in Ashlam, grade PR, a special purpose strong, but light, insulation and structural material developed for refrigeration applications. Material and moulding by Ashdowns Ltd.



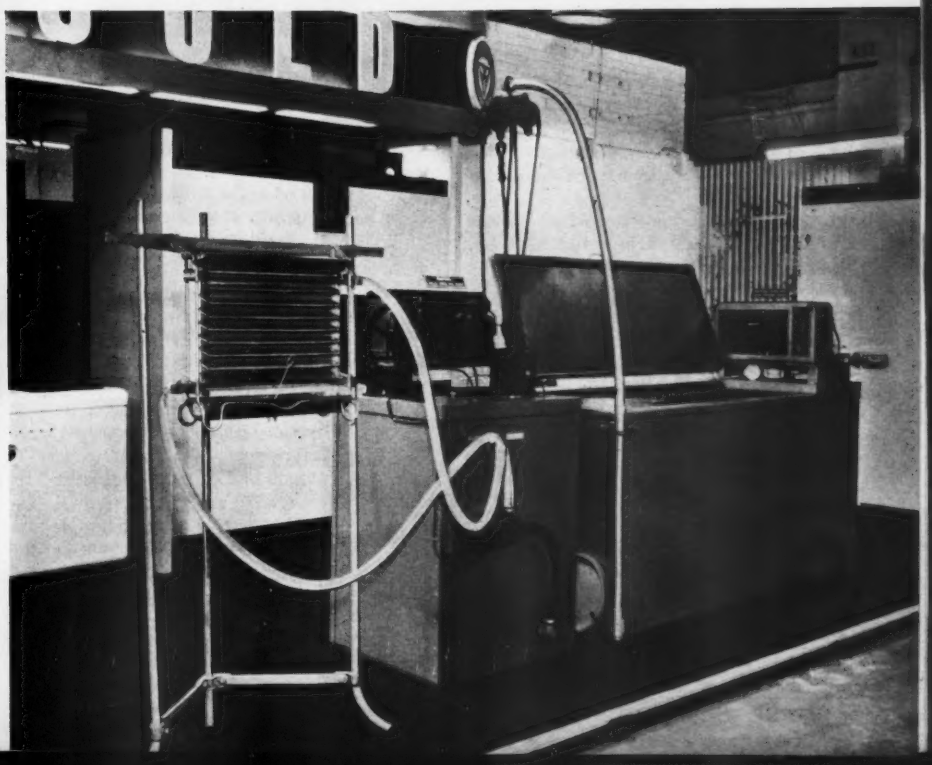
(Above) Rear view of side breaker strips injection moulded by Halex Ltd., from polystyrene for Prestcold Refrigerators. ("Plastics," January, 1953.)



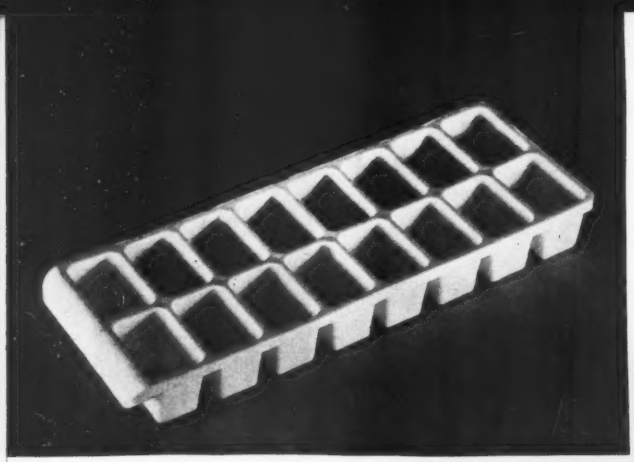
(Right) Polystyrene drip tray moulded by Ashdowns Ltd.



(Above) Inner door panel in Ashlam, grade PR (PRF) suitable for the application of synthetic baking enamel, moulded by Ashdowns Ltd.



(Right) Prestcold milk cooling unit employing polyvinyl chloride piping, which is non-toxic, tough, and translucent.

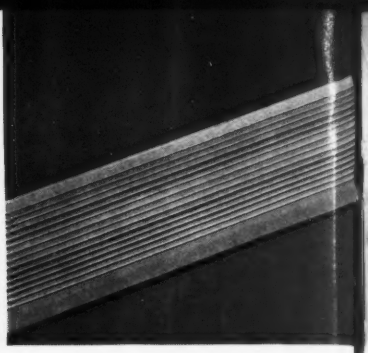


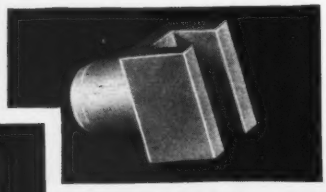
(Above) Polythene ice-separator, injection moulded by J. F. Kenure, Ltd.

(Right) Name plaque : two-colour moulding in polystyrene by J. F. Kenure, Ltd., for G.E.C. Ltd.

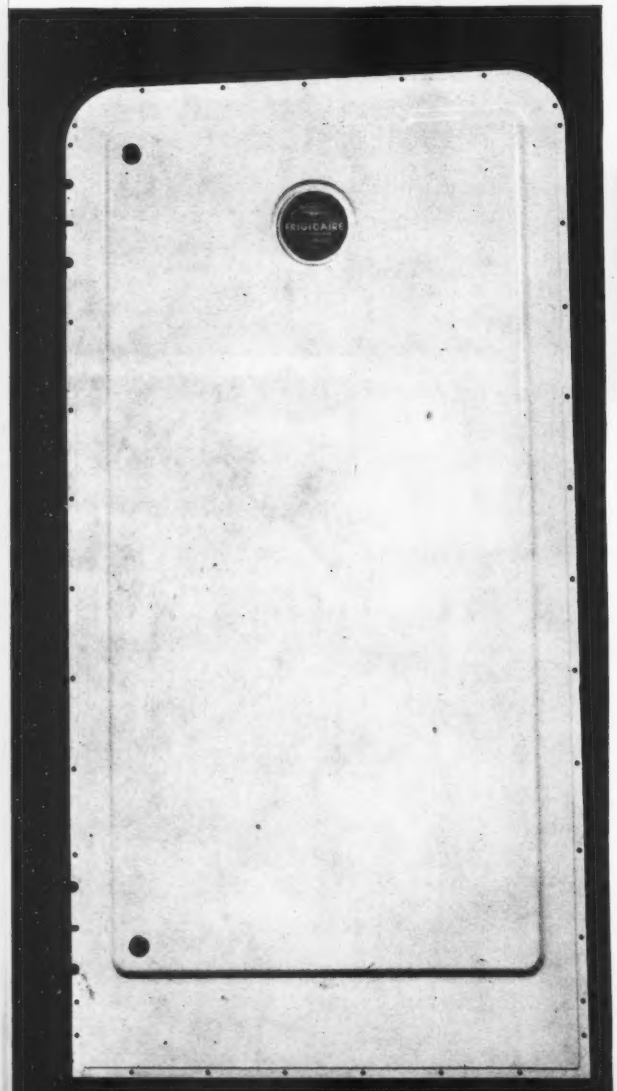
(Right) Extruded p.v.c. trim, manufactured by Ashdowns, Ltd., for the Kelvinator refrigerator.

(Below) Injection moulded polythene shelf support, by J. F. Kenure, Ltd.





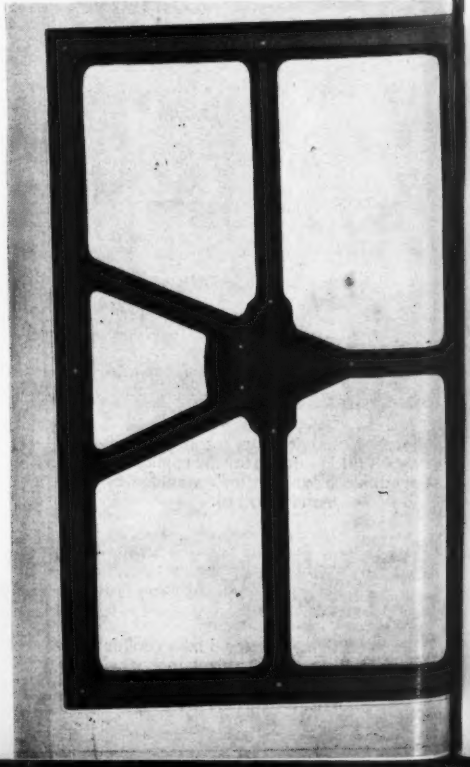
(Below) Hydrator base and lid, moulded in polystyrene, by Ashdowns, Ltd.



(Left) Inner door panel for domestic refrigerator moulded for Frigidaire refrigerators.

(Left) Temperature controller moulded in black polystyrene for Frigidaire refrigerators.

(Right) Refrigerator grille, moulded by Insulators, Ltd., for the Smithfield Refrigerator Company Ltd. from general purpose black phenolic moulding material.



Relieving Stresses in Polystyrene by Heat Treatment

BY E. E. HALLS

POLYSTYRENE is a very useful material not only in the form of parts made by injection moulding, but also as components machined from cast or extruded stock. Within the limits of its physical properties, it is exceptionally stable, this assertion applying in the chemical, electrical and dimensional senses. The reservations in the physical sense refer to the upper limits of operating temperature, which is about 60 degrees C., and solvent attack by, for example, hydrocarbons and chlorinated hydrocarbons. Possessing a very low power factor at radio frequencies, polystyrene is a low loss dielectric material. It is non-absorbent to water or moisture, and so retains its dimensions under exposure conditions which involve dampness. Freely mounted, it is also dimensionally stable under heat up to 60 or 70 degrees C., although if compressed it will exhibit plastic flow in the upper region of this range.

Sheet, rod and tube stock are produced by casting or extruding. Components machined from them are prone to exhibit failure due to cracking, although the defects may not make themselves visually perceptible for several days or even weeks after completion of the machine operations of cutting, drilling, milling, etc. If the original stock has been stress-relieved, machined components may withstand the machining stresses without failure; if it has not been so treated, it is unlikely that the parts can be relied upon in service without additional processing. A general procedure that can be recommended is to heat-treat the stock before, and the components after, machining.

The cause of cracking of the stock is stresses in the material, probably due to thermal strain, the outer layers cooling faster from the casting or extruding temperature than the inner ones; in extruded forms, this is supplemented by mechanical strain. In the case of machined parts, it is largely a question of mechanical strain, particularly in drilling when the drill is forced through, but thermal strain from local heating enters as well. Keen tools should be employed, and although polystyrene is quite "free cutting," a good flow of coolant should be maintained.

It is difficult to establish whether the material or component is dangerously stressed or not by viewing in polarized light, and, of course, this cannot be applied to opaque or translucent forms. A practical test comprises immersion in solvent, using a specimen carefully cut from the stock or one of the components. An American practice uses kerosene, immersing for one minute at 15 to 25 degrees C., and allowing to dry off naturally upon removal. A medium petroleum benzine or white spirit can satisfactorily be employed. Very badly stressed material may show cracks within a minute, whereas good material will be perfectly sound at the end of an hour.

In cutting samples for test from rod, the American practice is to use a wet saw, and cut a piece at least ¼ in. thick at a distance of at least three diameters from the end of the rod. Again, with a wet drill, they make four small holes axially, one at the centre and the other three spaced at radial distances of quarter, half and three-quarters of the radius from the centre. The holes can be 1-32 or 1-16-in. diameter.

The heat treatment for stress relieving needs to be as close to the critical temperature of melting (viz., 80 degrees C.) as is practically consistent with control of temperature with respect to oven load. A plus and minus limit of 1 degree C. is the best control that can be expected, and 77 degrees C. as the nominal temperature is selected as being safe in avoiding incipient fusion at the edges of the work.

For work up to a few inches linear dimensions, a treatment period of 16 hours is necessary. The work may be loaded into the hot, pre-controlled oven, but at the end of the time, the oven can be switched off, although work should not be removed till the oven has fallen to 40 degrees C. because slow cooling is essential.

The oven should be spacious so that work can be centrally located with the avoidance of hot spots or cool effect of the door area. An air circulated oven is preferred. The work must be systematically placed on trays so that each part is self-supporting in a manner to avoid distortion due to its own weight.

The same kind of treatment applies to mouldings if they are subjected to any machining operations such as drilling or tapping. Much trouble has also been experienced with mouldings in the "as moulded" condition, and this seems to be associated with faulty technique in the moulding process. Strains are set up in a moulding during cooling if the moulding is not free to contract naturally. It may, therefore, quite well be that should certain surfaces of the moulding tend to adhere to the tool, contractional strains are developed and the cracking trouble will result. Crazing or cracking may reveal itself shortly after moulding, or it can be developed by the process of immersing in solvent for a minute. In some cases it has been found that correction by heat treatment is not possible and that, after heat treatment, the parts will still craze or crack when immersed in kerosene or benzine. The correct technique of moulding has to be acquired to overcome such possible defects. The answer in the injection moulding process seems to be to have a restricted orifice so that the polystyrene is injected into the tool at high velocity and stands the best opportunity of reaching the remote parts of the tool without loss of temperature, and in such a way that it therefore has the opportunity of being subjected to a uniform compression throughout its mass. Properly moulded components do not appear to develop cracks unless of course they are subsequently machined, which adds new strains.

Failure of polystyrene machined components and mouldings due to cracking is not only annoying but it leads to delay and unnecessary expense. From the foregoing, it is evident that the heat treatment procedure proposed is quite a tricky one in so far as the whole of the load of work must be brought up to temperature, and this temperature must be closely controlled because of its proximity to the melting point of polystyrene. With judiciously selected equipment, properly controlled, no troubles result and the application of the heat treatment to stock before machining, and to parts that are machined, justifies the effort spent on planning the job.

Mr. W. E. Mitchell

We very much regret to announce the death of Mr. W. E. Mitchell, Midland and Northern Sales Manager of James Ferguson and Sons, Ltd. for approximately twenty-one years.

He died suddenly on February 11, 1953, and will be very much missed by all his many friends in the plastics industry.

His earliest association with the plastics industry was with Messrs. Joseph Lucas, Ltd., at their Formans Road Works, before joining James Ferguson and Sons Ltd., on September 1, 1932.

Mr. John Ferguson, Managing Director, writes as follows:—

"In the passing of W. E Mitchell we have lost a loyal and energetic colleague. With him the job always came first, and in difficult times it was always a pleasure to meet Mitchell's optimism. He was always so well liked amongst our many customers in the Midlands and the North on account of his bright and cheerful personality, and the service he gave was always of the highest character. He never spared himself for one instant, and we shall all miss him very much."

ART IN INDUSTRY

THE results of the tenth Industrial Design Competition, organized by "Art and Industry", have been announced. This competition was sponsored by Hughes Brushes Ltd., for the design of a set of three plastic toilet brushes.

Although the number of entrants was not large, the high standard which has been a feature of this series of competitions was maintained.

We publish herewith a list of the prize-winning designers and extracts from the judges' report.

The prizes were allocated as follows:

£40, *Hereford*, J. Stimpson, Birmingham.

Four prizes of £15 each to:

Engi, R. Reynolds, Birkenhead.

Raven, R. Merritt, Colchester.

Walt, R. Walter, Coventry.

Yenton, J. Brooks, Erdington.

The pseudonyms of the contestants are used throughout the text of the judges' report. The judges were Miss Phyllis Garbutt, Principal of the Good Housekeeping Institute, Miss Kathleen Frost, director of the "Studio", and Mr. S. Riché.

The sponsors were not represented on the panel of judges, but two of their technical representatives were at hand for consultation.

Judges' Report

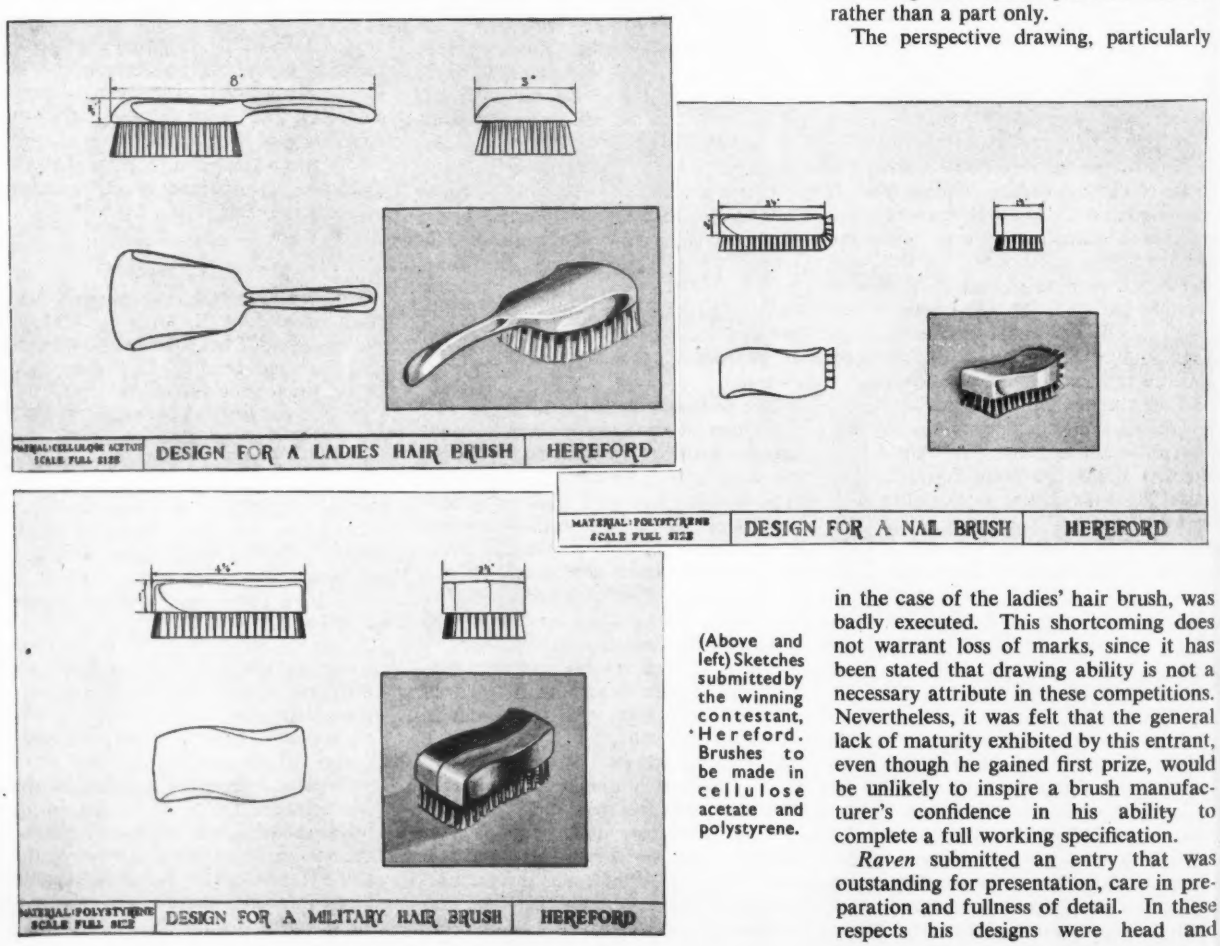
The first prize was awarded to *Hereford* because his was one of only two entries in which the three types of brush were treated as a family, because his plans were clearly drawn and because the shapes he evolved were well suited to their respective uses. His best design was for the ladies' hair brush. His other two brushes were somewhat lacking in visual appeal, although the models he provided were capable of demonstrating sound practical attributes including mouldability in thermoplastic material. He did not submit a model of the ladies' hair brush, which, although lending itself to plastic moulding, was not an easy shape to carve out of the solid, except by a skilled craftsman.

Both the military and the nail brush were designed for use in the right hand, the "S" curve of the sides forming a satisfactory grip. Although apparently unsuited to left-handed use, it transpired that no discomfort was experienced when handled in this way. This property would seem to suggest, therefore, that little object was really gained by introduction of the "S" curves. The military brush was just a little too narrow to be comfortable.

The drawings were too non-committal in their lack of detailed specification. For instance, no information was given as to the size of the knot holes, their number, spacing and staggering other than could be gained from the drawings in elevation. The designer may well have felt that any brush manufacturer interested in the design would look upon such details as his own particular province. Nevertheless, a brush without tufts is no better than an empty plate for dinner and the sponsors were interested in seeing the whole problem tackled rather than a part only.

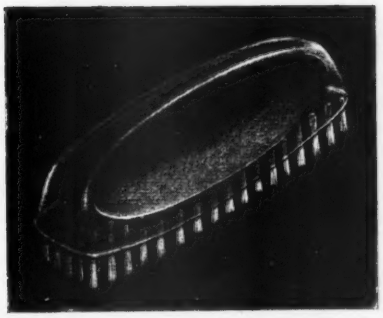
The perspective drawing, particularly in the case of the ladies' hair brush, was badly executed. This shortcoming does not warrant loss of marks, since it has been stated that drawing ability is not a necessary attribute in these competitions. Nevertheless, it was felt that the general lack of maturity exhibited by this entrant, even though he gained first prize, would be unlikely to inspire a brush manufacturer's confidence in his ability to complete a full working specification.

Raven submitted an entry that was outstanding for presentation, care in preparation and fullness of detail. In these respects his designs were head and



(Above and left) Sketches submitted by the winning contestant, Hereford. Brushes to be made in cellulose acetate and polystyrene.

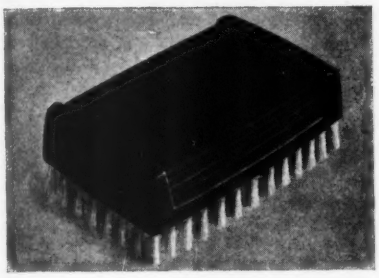
shoulders above all others and would serve as a model to many professional designers. Each brush was the subject of a folder composed of stiff card sheets with the package design appearing in each case as the first working sheet and comprising a Cellophane-covered window cut to the package contour in perspective and, revealing through it, the perspective in colour of the brush itself on the next card. Each carried a neatly pasted typewritten specification and the last a large folded photostat of the working drawings. A fourth folder contained a short typewritten description of the designer's approach to the problem.



Another design submitted by Raven revealing his bold use of plastics materials.

This entrant displayed a sound knowledge of plastic moulding technique and an all-round attitude toward the set problem that could not fail to inspire confidence in his ability. The main criticisms were concerned with his choice of individual shapes, particularly for the ladies' hair brush, which had masculine appeal rather than feminine. The female hand does not take kindly to a handle of flat ruler-like shape and the lady is apt to feel prejudiced against it, even though it may be manipulated more comfortably than she imagines.

In the case of the military brush, the question arose as to whether men would not prefer a simpler shape, if not oval in plan, then at least without some of the surface recesses which, it was felt, might create more sales resistance than would be counterbalanced by any practical value. The nail brush was probably the most satisfactory. Its clean lines suggested an object that would be pleasant to hold and its form appeared to offer a sensible grip, although a model for actual test would have been desirable.



Perspective view of brush designed by Raven.

Model of ladies' brush designed by prize-winner Engi.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Anti-corrosive Materials

SIR,—We note with interest in the January number of *Plastics* the overseas inquiry for information on materials suitable for the lining of petrol and oil tanks against corrosion.

We have a range of anti-corrosive materials which are marketed under the trade name of "Vulkrete," and in 1951 we undertook the lining of an oil tanker with our material in order to obtain practical experience of its properties against all types of petroleum products. The tanker has been examined on two occasions since the lining was inserted, and the results have shown that in spite of changing the types of petroleum, which range from high-octane fuel to crude oil, and constant washing with hot sea water, the lining has been unattacked and the metal beneath has remained in excellent condition.

In most discussions with manufacturers of oil tankers it has been stated that hundreds of anti-corrosive materials have been tried, some of them in the form of paint or very thin surfaces which are applied to the metal. Some of them remain satisfactory for six months, but after this period the washing of the oil during transit and the effects of the sea water which is sprayed in at high pressure, causes deterioration of the thin wall coating. We had this point in mind in the development of "Vulkrete," and we feel that from January, 1951, when it was applied, until the end of 1952, when the tanker was last examined, we have every reason to think that we have passed the difficult first six months, and are now proceeding to obtain information over a period of three years which should substantiate finally our claims for "Vulkrete."

VEEDIP LTD.

St. Helens Works,
Slough,
Bucks.

P.v.c. Sheet Welding

SIR,—Perhaps you would be kind enough to advise us of welders of p.v.c. sheeting.

IRENE MANUFACTURING CO.

5 Betterton Street,
Drury Lane,
London, E.C.1.

Laminating Press

SIR,—I require a small laminating press suitable for laminating identification cards, snapshots, etc., and shall be highly obliged if you will let me know the sources from where I could get the same.

THE MAYFAIR AGENCY.

327 Hornby Road,
Bombay 1, India.

Materials for Handbags

SIR,—We wish to find, for export, materials suitable for the manufacture of handbags, and should be pleased if you could mention names of suitable manufacturers among your subscribers. The material should be cotton-backed.

A. G. FIELD AND CO., LTD.

10 Devonshire Row,
London, E.C.2.

Plastic Wall Plaque

SIR,—We have recently received from British Guiana a sample of a plastic wall plaque, incorporating a spray of flowers in the centre, and are wondering whether you can put us on to manufacturers.

We also want a similar article with a photograph of Her Majesty The Queen instead of the flowers, in a suitable assortment of pastel shades.

JOSEPH, BOND AND JEANS, LTD.

20 Copthall Avenue,
London, E.C.2.

Plastic Balls

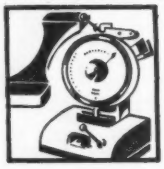
SIR,—I have received inquiries from time to time by science teachers and others for the name of a firm who could supply plastic balls of $\frac{1}{4}$-in. and $\frac{3}{8}$-in. diameter in strong colours. These are wanted for use in constructing models of molecular structure.

I cannot, of course, promise large orders, but I should like to be in a position to advise where such may be obtained.

ASSISTANT KEEPER,
The Royal Scottish Museum.
Edinburgh, 1.

World's Industry Employs Plastics

MATERIALS and TESTING



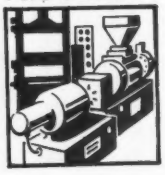
Review and Forecast.—T. C. Du Mond, in his annual report on engineering materials, believes that in spite of much progress still more developments can be expected soon, particularly in the field of high temperature materials. (*Materials and Methods*, 1953/Jan./108.)

Properties of Plastics were determined on small samples by K. H. C. Bessant and coll. The materials investigated included hard plastics (polystyrene and polymethyl methacrylate) and elastomers (polymethyl acrylate, plasticized polyvinyl chloride). (*Journ. Appl. Chem.*, 1952/Vol. 2/501.)

Foam materials and their application.—P. Hoppe gives a survey of the modern foam materials, i.e. materials with a specific gravity below 0.4 (natural light materials, cork, balsawood and natural sponge have specific gravities of 0.3 to 0.1); the requirements and physical properties as well as numerous applications are described in detail. (*Kunststoffe*, 1952/Dec./450.)

Strength of injection moulded parts.—A difficulty for the calculation of the strength of plastic components is the considerable influence of the moulding process. Examples are given for compression and injection moulded parts. (*Kunststoffe*, 1952/Dec./460.)

PROCESSES : MACHINERY



Simple R.F. Heat Sealing Device for thin plastic containers.—This report describes the construction of a small power R.F. heating device for making 3/16-in. wide seals at a rate of 18 inches per min. on polyvinyl chloride, Pliofilm, cellulose acetate and nylon sheet or film. A power of 30-50 watts R.F. is used at a frequency of 35 to 40 megacycles. The roller work head, which is power driven, is connected to the equipment by means of flexible cables 1.1 to 2 yards long. (Atomic Energy Research Establishment Harwell. Report C/R 1004, 1952.)

Perspex windscreen.—The making of a Perspex windscreen for a motorcycle is described in detail by H. C. Piggin. (*Mechanics*, 1953/Feb. 13/310.)

Injection moulding.—The present state of injection moulding of materials such as polyethylene, polytetrafluoroethylene, polyacrylic-acid ester, polyamides, etc., is described, as well as methods for materials which cannot be injection moulded and have to be treated by a powder compacting method. (*Industrie-Anzeiger*, 1953/Feb./141.)

INDUSTRIAL APPLICATIONS

Use of p.v.c. in the manufacture of non - inflammable conveyor belts.—Polyvinyl chloride has been used, with suitable placticizers to replace rubber in conveyor belts. Such a belt is completely non-inflammable and has superior wearing qualities. The report gives details of exhaustive tests and outlines the characteristics and advantages of p.v.c. impregnated and coated conveyor belts. (National Coal Board, Scientific Department, Research Report No. 1.)

Foam plastics are increasingly used as lightweight stiffeners in aeroplane design. (*Aviation Week*, 1952/Vol. 57, No. 17/35.)

Moulded nylon cable hangers are lightweight, flexible and smooth with rounded edges, and have high tensile strength. Resistant to sustained temperatures from −60 to 250 degrees F. the clips retain their original shape permanently. (*Materials and Methods*, 1952/Dec./114.)

Filters of plastic sieves.—In a Russian technical journal the advantages of plastic sieves made of glass fibre woven materials are compared with metal sieves. (*Gidrotechn. Stroitel' Stvo Moskwa*, 1952/Vol. 21, No. 9/37.)

Polyvinyl chloride fan.—A large industrial ventilating fan was made entirely of Lucoflex, unplasticized hard p.v.c.; it proved as efficient as a metal fan. (*Materials and Methods*, 1953/Jan./91.)

Welded blowers.—W. Schmitz describes the design and production of blowers made of hard p.v.c., which are increasingly used by the chemical industry. (*Künststoffe*, 1952/Nov./95.)

Driving belt of Perlon.—Owing to its high tensile strength Perlon is now used for endless woven belts for transmitting speeds up to 60,000 r.p.m. on small capacity drives. (*Industrie-Anzeiger*, 1953/Feb. 3/122.)

Sandcore bonding.—A new liquid phenolic resin produced by Durez Plastics and Chemicals Inc., North Tonavanda, N.V., is said to have longer storage life, lower cost, excellent bonding strength and low volatility. (*Materials and Methods*, 1953/Jan./140.)

MISCELLANEOUS USES

Plastic materials for optics.—Details are given of eight monomers suitable for optical applications. A method for determining the optical sensitivity of plastic materials for cases where optical creep is a function of stress, is presented. A study has been made of the effect of catalysts and polymerization accelerators on curing time, internal temperature rise and physical properties of commercial and experimental monomers suitable for electrical embedding materials. Various mixtures based on styrene were prepared in an attempt to develop a material having sufficient flexibility to withstand thermal shock and to have a low power factor at the higher frequencies. (Armour Research Foundation, Chicago Formal Report No. 9, 1949/April/PB105987, T.I.D.U. Microfilm.)

Lightweight bandages of foam plastics.—As a replacement of plaster of Paris casts foam plastics are now applied which are easily formed, are flexible, hygienic and allow respiration. They permit free penetration of X-rays. (*Kunststoffe*, 1953/Jan./8.)

Wrapping of foodstuffs.—H. Klingelhœffer describes the requirements for plastic wrappings for foodstuffs from the commercial, legal and technical point of view which makes special testing techniques necessary. An increased use of combination packing materials is expected. (*Kunststoffe*, 1952/Dec./465.)

Applications of glass fibre filled moulding resins.—K. Rose describes recently developed compounds for small pieces and parts of varying thickness. The following resins are applied: alkyd, silicone, fluorocarbone, polyester, phenolic and polystyrene resins. (*Materials and Methods*, 1953/Jan./87.)

Conservation of biological preparations.—A casting resin, Celodal, which cures when adding an accelerator is described in detail by H. Tischer. (*Kunststoffe*, 1952/Dec./103.)

Plastics in the paper industry.—S. R. Sheeran reviews the uses of polyvinyl alcohol and of polyvinyl acetate in paper making. (*World Paper Trade Review*, 1952/Vol. 138/1382.)

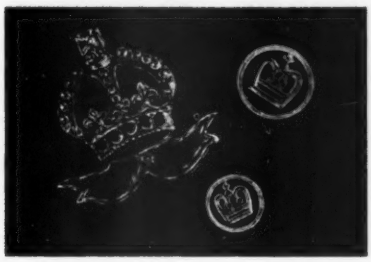
Symposium on the Hungarian Plastics Industry includes suggestions for the rationalization of this industry and the recommended adoption of high frequency preheating of moulding powders. (*Journal of the Hungarian Chemical Soc.*, 1951/Vol. 6 (No. 6)/174.)

Coronation Souvenirs

A further selection of souvenirs for the Coronation which employ plastics materials in their production are presented here. Among them are four which have been selected by the Coronation Souvenirs Committee of the Council of Industrial Design, for presentation with a Merit Award. These are indicated below by a star (★).

(Above) ★ Mirror, set in clear polystyrene frame, with reverse decoration incorporating crown, by David Strasburger, Ltd.

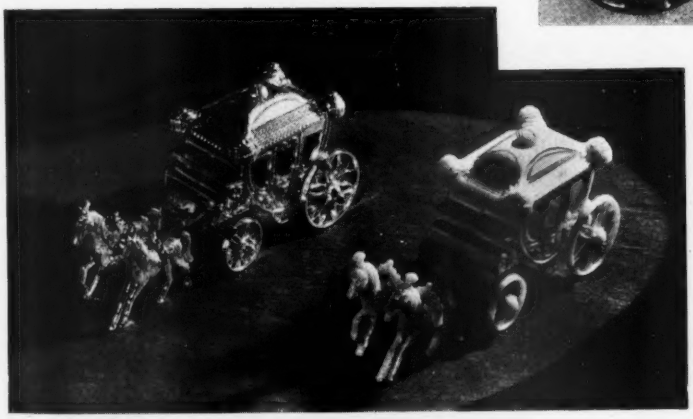
(Above) ★ Cellulose acetate bowl with Diakon acrylic lid, by Wilmot-Breedon, Ltd., employing the "three-dimensional" decorating technique.



(Left) Brooch of metallized plastic and button [in] crystal Perspex, by Plastic Industries (Fancy Goods, Ltd.)

(Right) Clear polystyrene brooch, with "three-dimensional" metallic effect, by Robert Stross, Ltd.

(Above) Perpetual calendar by W. C. Youngman, Ltd., with transparent polystyrene presentation case moulded by British Plastic Developments, Ltd.



(Left) ★ Coronation coach in blue or metal-plated cellulose acetate, by Combex, Ltd.

(Left) Coronation medallions in metal-coloured cellulose acetate, moulded by Dines Products for Philip and Tacey, Ltd.

(Right) ★ Calf-grained plastic hand-bag with Royal Coat of Arms, by Metrolite, Ltd.

Vinyl-type Polymers in Surface Coatings

By W. A. EDWARDS, M.A., F.R.I.C.

BEFORE 1945 the great majority of the synthetic or the partly synthetic finishes produced by the surface coatings industry were based on modified thermosetting resins of the phenol-formaldehyde, urea-formaldehyde, or alkyd types. These still remain the most popular and widely used materials, and they are in a continual process of development, but during the last six years a number of thermoplastic vinyl-type polymers have become firmly established in industrial use, and it is likely that this development will expand rapidly in the next few years. Already their use has enabled the industry to produce a number of novel and useful products which could not be made using the older raw materials.

It is proposed to describe some of the present uses of these polymers. The vinyl esters themselves have found a number of applications for special products which have become commercially important.

Polyvinyl Butyral

The main application of this resin has been in the preparation of etching primers for ensuring good paint adhesion to difficult surfaces, which are now being used to a considerable extent, particularly on light metal alloys, where they are showing signs of becoming the counterpart of phosphate treatment for steel articles prior to painting. The primers consist simply of solutions of the butyral in mixed solvents, with alcohols predominating, lightly pigmented with zinc chromate or zinc tetrahydroxychromate, to which is added phosphoric acid or a mixture of phosphoric and chromic acids. Such primers adhere strongly to most metal surfaces, and have found wide use on aluminium alloys, zinc and its alloys, brass, and even chromium plate. They can be overcoated with most of the customary air-drying or stoving finishes to give paint systems which adhere as strongly as the primer itself. Curiously enough, they also show good adhesion to glass and many plastics. They dry in a few minutes, which makes them eminently suitable for modern industrial requirements, and if desired they can be given a short stoving period, which confers improved adhesion and water resistance.

The exact mechanism of their action is obscure, and it appears that a chromate is a fundamental ingredient, other pigments failing to yield comparable adhesion. When undercoating and finishing coats of good quality are used with them, the results obtained are outstanding. A paint system which would flake severely in a few months from an aluminium alloy under stringent conditions such as sea water immersion, will generally remain intact for a considerably longer period if an etch primer is first applied.

Fig. 1 illustrates the improved performance of a marine paint when used with an etch primer. The two specimens, A and B, are 6 in. x 3 in. and are both aluminium alloys, but of differing compositions. The lower part of each was treated with etch primer and the whole then painted with the finishing paint, a material made from tung oil and a phenol-formaldehyde resin. The specimens were then scratched to expose a strip of bare metal and immersed in sea water for four weeks. It can be seen how blistering has been confined to the upper half, where there is no primer present.

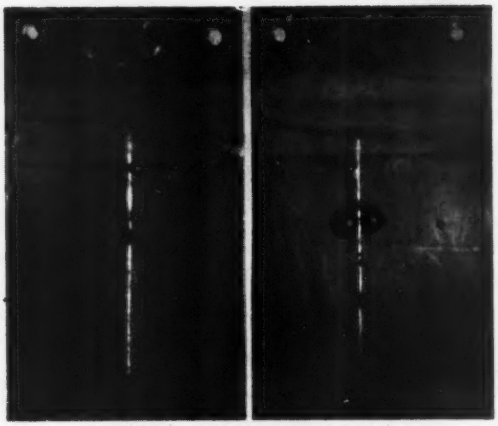
Polyvinyl Acetate

Straight polymers of vinyl acetate are not entirely suitable for the preparation of varnishes or lacquers, although used to some extent, but they are now commonly used as ingredients of decorative emulsion finishes, which are proving increasingly popular. The polyvinyl acetate emulsion is prepared by polymerizing an emulsion of the monomer, so that the cost of the resin is reasonably low. To it are added suitable pigments, titanium oxide or lithopone being customary as the white base, together with the necessary staining pigments to produce the pastel shades in which this class of paint is usually required. All the pigments are preferably added as a slurry in water to which a suitable wetting agent has been added, and thickening and suspending agents and plasticizers may also be added. The resulting paints are easy in application, and can be thinned, if desired, with water, which is also used for cleaning brushes or spray guns. They flow well and dry rapidly to a comparatively waterproof film which will withstand frequent washing. The slight odour of the paint is not unpleasant, and rapidly disappears as drying takes place, so that there is considerable outlet for painting restaurants and other premises where the odour of oil paint might be thought objectionable. Thus we have a virtually odourless material which combines the ease of application of a distemper with a performance approaching that of a flat oil paint, at a lower price than that of the latter.

A comparable development in America is the use of emulsions of copolymers of styrene and butadiene, which are claimed to be even better in performance than those based on vinyl acetate. The supply of the necessary raw material is, of course, extremely good in the U.S.A., since similar copolymers are used in the manufacture of synthetic rubber. It is unlikely that butadiene will become commercially available here for a very long time, so that British development on these lines is likely to be confined to improvements in the vinyl acetate products. It has been recently estimated that the consumption of styrene-butadiene latex paint in the U.S.A. is in the region of ten million U.S. gallons per annum.

Vinyl Acetate-chloride Copolymers

The solubility characteristics of polyvinyl chloride alone are not those desirable for a varnish ingredient, so that there have been developed copolymers of the acetate and chloride in which the useful properties of both materials are combined in their optimum proportions. Resins of this type are soluble in ketone solvents, but tolerate considerable additions of diluents such as hydrocarbons. The ketones of lowest molecular weight produce solutions of the lowest viscosity, but higher boiling solvents are also used to confer adequate flow. As a result, it is not possible to prepare varnishes having a



(A) (B)

Fig. 1.—Etch primer. Blistering of paint on untreated portions of aluminium specimens.

high solids content. Nevertheless, by selecting pigments of high obliterating power it is possible to arrive at coloured lacquers with an acceptable degree of gloss, which are resistant to dilute acids and alkalies, petrol and other hydrocarbons, and a variety of other possible destructive influences.

There have been three principal developments using these resins:—

Stripping lacquers. The manufacture of stripping lacquers for the temporary protection of bright metal surfaces. These are highly plasticized, and can be easily peeled from the surface before use. The use of degreasing solvents, which are required for many temporary corrosion preventatives, is thus avoided.

Anti-corrosive enamels. Preparation of acid, alkali and petrol-resistant enamels for use under severe conditions, such as in plating shops. These finishes are quick drying, but somewhat difficult to brush, and suffer from the fact that dried films are soluble in superimposed coats. Spraying overcomes these defects to a large extent.

Stoving lacquers. Manufacture of stoving lacquers for industrial use. For this purpose those resins in which small amounts of unsaturated aliphatic acids, such as maleic acid, have been copolymerized, are now popular, since with their use films possessing tenacious adhesion to aluminium alloys and many other metal surfaces can be formulated. Stoving times for these products are short, a few minutes to remove the last traces of solvent being all that is necessary. There is no doubt that when the raw materials needed are more readily available such lacquers will become popular for finishing a variety of mass-produced articles, especially where adhesion problems have been experienced with the traditional stoving enamels, and where the finish is required to stand severe conditions in use. They will, for instance, withstand contact with oils and fats, fruit juices, soap and soda solutions, petrol and benzole. Their main defect is their poor resistance to high temperatures, often found with chlorinated compounds.

Styrene

Polystyrene itself finds only limited use in the varnish industry at the present time. This is perhaps surprising, since it is soluble in cheap hydrocarbon solvents such as xylol, and gives solutions of reasonably high solid content which can be plasticized effectively with most of the plasticizers in common use. In addition, polystyrene is unsaponifiable and would thus suggest itself for use on alkaline surfaces such as cement and plaster. In aluminium and bronze paints its lack of acidity would also appear to make it a desirable ingredient.

The most spectacular outlet, however, has been as an important constituent of "zinc-rich" priming paints for steelwork. Although zinc dust paints are no innovation, the work of Dr. U. R. Evans and Dr. J. E. O. Mayne focused attention on these particular primings when published in 1944. They are designed to produce a film containing 95% of metallic zinc, which ensures that the metal particles are in contact with themselves and also with the underlying steel. Thus they can afford cathodic protection to the surface in the same way as galvanizing. The paints are, in fact, often referred to as "cold galvanizing solutions," and have the property of protecting steel across any discontinuity in the priming film, such as a scratch which exposes a strip of uncoated metal. This will remain free from rust for a very long time.

The choice of a medium for such an unorthodox paint is not an easy one, but it was found that polystyrene was extremely suitable, the freedom from acidity providing good storage properties, and the resistance to saponification improving the performance when compared with saponifiable media. In addition, the zinc dust settles less than in other solutions, and the film is well bound and adherent, despite the unusually high pigment content. At the present time substantial quantities of zinc-rich paint are being manufactured for use in the protection of steelwork, and in most cases polystyrene is the medium.

Copolymers of Styrene with Drying Oils

Since 1945 an important new industry has arisen in this country for the manufacture of these materials. Although polystyrene itself is insoluble in drying oils, it has been found that when styrene and alpha-methylstyrene are polymerized in presence of the oils, varnishes of novel properties are produced. The type of drying oil can be varied considerably (or an oil modified alkyd resin used instead), and the reaction can be carried out in solution, in emulsion, or in bulk, and possibly in the presence of other polymerizable materials. Obviously it is thus possible to produce an extremely wide range of varnishes of different types.

The styrene-oil copolymers now in industrial production have valuable properties, including low acidity, good speed of drying, and excellent durability and gloss retention, the latter approaching that of alkyd resins. The copolymers with alkyds are even more rapid drying, and possess superior resistance to water and alkalies when compared with straight alkyds.

There is still considerable discussion on the exact nature of the structure of these materials, but it is now well established that at least some copolymers of styrene and the fatty acid molecules are present. Production of the materials is already substantial, and it is certain that development will continue to be rapid.

Methacrylic Esters

Polymethyl methacrylate and polybutyl methacrylate have found a number of limited uses for special purposes for many years, producing, as they do, water-white films of good light fastness and flexibility, but the total quantities used at the present time do not compare with those used of some of the materials mentioned earlier. A promising use which now finds some application is the blending of butyl methacrylate resin with silicone resins. The latter are excellent media for finishes which are required to withstand severe heat, but it is necessary to stove them at a comparatively high temperature in order to develop satisfactory initial hardness. Blends with butyl methacrylate, however, air dry to a reasonably hard film and although they discolour at high temperatures more than the unmodified silicones, the results are often adequate for the purpose in hand, and greatly superior to those given by urea- or melamine-formaldehyde resins.

Other Resins

Although the materials described above are the more important of those used at the present time, they do not constitute the whole of the addition-polymerization resins now being used. Coumarone-indene resins, for instance, are well established and are used in substantial amounts. They also are valuable owing to their lack of acidity and to the fact that they are unsaponifiable. Many excellent heat resisting paints are based on these resins, particularly when used in conjunction with aluminium or bronze powders. Cyclopentadiene resins have received considerable attention over the past few years, and there are, of course, many others.

It is interesting to note that the developments which have been detailed constitute the majority of the more interesting advances in paint and varnish technology which have taken place since 1945, so that the accent has been very much on vinyl polymers. One desirable result of this is that it is now possible to produce quality finishes with much higher proportions of home produced raw materials than was the case prior to 1945, since the monomers used can all be manufactured in this country, and in many cases this is already

(*Continued on page* 91)

Tensile Impact Properties of Some Plastics

By BRYCE MAXWELL, T. P. HARRINGTON, ROBERT E. MONICA

This paper, published here by courtesy of the Society of Plastics Engineers, Athens, Ohio, is reprinted from the "S.P.E. Journal," December, 1952.

THE standard tests for mechanical properties of plastics have been derived from the traditional tests for metals. Tests of such properties as tensile strength, flexural strength and impact strength performed under the existing standards yield data useful in the design of structural components when the applied service loading is similar to the test conditions. All too often the assumption is made that the test data can be used for applications subjected to loading or environmental conditions which differ radically from the test conditions.

In transposing the mechanical tests from metals to plastics few changes have been made. Since plastic materials are very different from metals, tests performed by these methods do not give all the desired data. Efforts to correct this situation have, to date, taken the form of devising additional tests specifically for plastics which, when considered in conjunction with the traditional tests, yield information which can be used for design purpose. Unfortunately this approach leads the materials engineer to think of plastic properties in comparison with the older materials, the net result being that plastics are often applied as substitutes for other materials, rather than as materials being applied for their own unique properties.

Considering the problem of the physical properties of plastics from a detached point of view, one immediately sees that the important features of these materials are their time and temperature sensitivity. Obviously, any physical test for these materials should not only take these factors into consideration, but should so measure their effects as to permit the constructive utilization of these features. Some form of dynamic test seems to be indicated.

Impact tests are sometimes referred to as dynamic tests, but if they are performed only at one specific velocity and one specific temperature they yield no more data about the time and temperature sensitivity of the material than a standard slow-speed flexural test. The impact properties of plastics are important to the design engineer for two reasons. On the one hand, he needs to know the minimum impact strengths of the weaker materials so that he can design against accidental failure. On the other hand, he needs to know the impact resistance of the stronger materials so that he can use them in the design of components as impact resistors where high-speed blows are expected. Measurements of the strength of these materials over a wide range of rates of straining and temperature are needed.

The history of impact testing of plastics has been reviewed in an earlier paper.[1] The present work might be described as a continuation or extension of this work. Results similar to those obtained for polymethyl methacrylate in tension impact at various rates of straining and temperatures have been obtained for several additional polymers. These results are interpreted for use as engineering design data and also used to obtain a more fundamental understanding of the effect of polymer structure on impact strength.

Basic Theory

The energy that a specimen can absorb in tensile impact test depends on the load deformation curve. The area under this curve is a direct measure of the energy required for failure. In general, thermoplastics exhibit a load deformation curve similar to (A) in Fig. 1 at low rates of straining. As the load is applied there is a small elastic deformation followed by a yield and plastic flow. At the point (A) failure begins and the crack grows through the specimen cross-section until it has completely failed at point (2). At higher rates of straining the load deformation curves change in shape similar to (B) and (C) until at very high rates of straining essentially linear load deformation curves similar to (D) are found.

The area under these curves depends on several factors, the more important of which are the load at the yield point, the load during the region of plastic flow, the deformation at which failure starts, and the amount of energy required to propagate the crack across the specimen cross-section. Each of these factors will be considered in detail.

The slope of the first portion of the curve depends on the force required to bend the bond angles of the polymer chains. Since this type of deformation is not time dependent, the slope of this part of the curve does not depend on the rate of straining.

The load or stress at the yield point depends on the force required to uncoil polymer chains at the rate determined by the rate of straining applied to the specimen. This is a time-dependent process. The higher the rate of deformation, the greater the force required to uncoil the chains at this rate.

Once the yield point is reached a distinct reduction takes place locally in the cross-sectional area of the specimen and true plastic flow occurs. The amount of stress required to produce this flow at the applied straining rate depends on the force required to slip chains past each other. The higher the rate, the greater the force required. This load is, of course, dependent on the cross-sectional area.

The amount of energy required to propagate the crack across the specimen section is measured by the area A-1-2 (Fig. 1). As the rate of straining is increased, this energy seems to decrease. This decrease is partly due to the increased rate causing the crack to propagate across the specimen more rapidly and to the added amount of elastic energy stored in the specimen at the higher rates of straining. This added elastic energy is released when the failure starts and thereby assists in

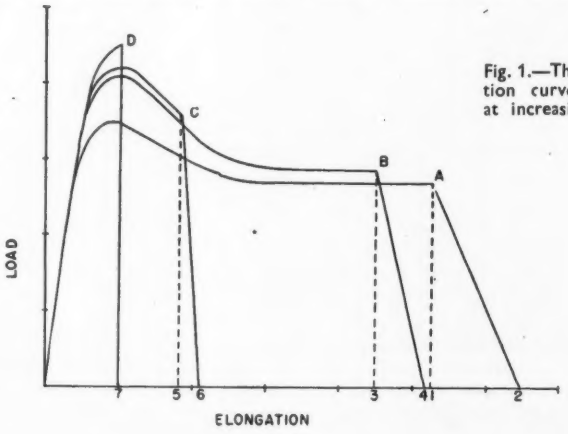


Fig. 1.—Theoretical load deformation curves for thermoplastics, at increasing rates of straining.

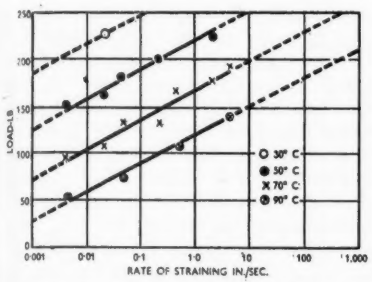


Fig. 2.—Load v. rate of straining.

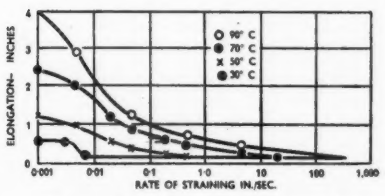


Fig. 3.—Elongation v. rate of straining.

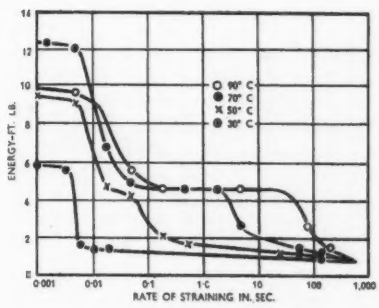


Fig. 4 (right).—Impact energy v. rate of straining.

propagating the crack. Measurements of the tensile impact strength can be corrected by not including the area A-1-2 for this energy to propagate (3) the crack if it is felt that this is not a part of the tensile impact energy measurement.

A theoretical approach indicates that as we increase the rate of straining we should find two distinct breaks in the energy curve. One associated with the polymer molecule chain-uncoiling mechanism and one associated with the chain-chain slipping.

Results and Discussion

The points plotted on the various graphs are usually the average of two to five tests. In the medium-velocity range these points are nearly always the average of three tests, although in a few cases five or more tests were performed and averaged. In the low-velocity range, the plotted points are usually the average of two or three points. For the highest-velocity range, the points were determined by averaging from three to ten tests, since a considerable amount of scatter in the energy values was sometimes found at the highest rates of straining.

The results of tests at 30, 50, 70 and 90° C. are plotted v. log. rate of strain for polymethyl methacrylate in Figs. 2, 3, 4. The specimens used for these tests were machined from a commercially moulded ¼-in. thick sheet.

It was observed from the load deformation curves that extremely little energy was used up in propagating the crack across the specimen once it had started. Therefore we can assume that the energy measured is almost entirely made up of the elastic and plastic energy absorbed by the specimen.

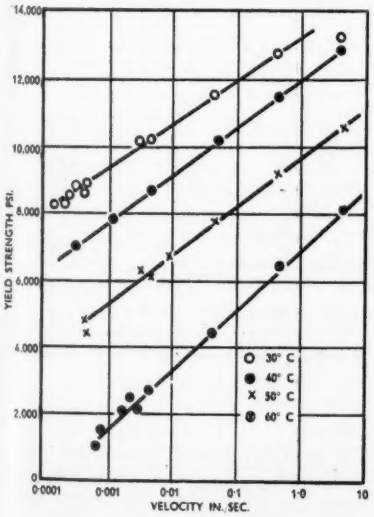
In Fig. 2 the maximum load v. log. rate of strain is plotted. At each temperature it is seen that the maximum load increases linearly with the log. rate. This is the usual trend found in such materials and is to be expected since the breaking phenomena is time dependent. As the straining rate increases, a higher stress is reached since it takes a definite time for the failure to take place.

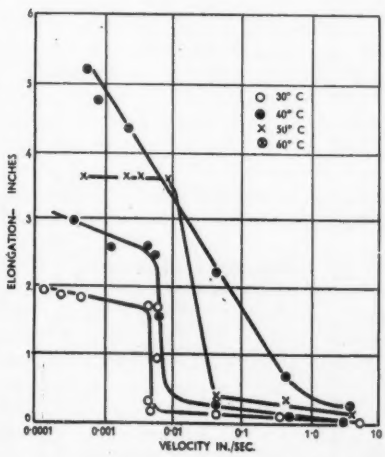
The elongation at break as a function of log. rate of straining is shown in Fig. 3 for the various temperatures. No linear relationship exists here, but there is a general trend to lower elongations as the rate of straining increases. The energy absorbed is dependent on both the elongation and the load, and since the load increases with increased rates of straining and the elongation decreases, we should not expect to find a simple relation between energy absorbed and rate of straining.

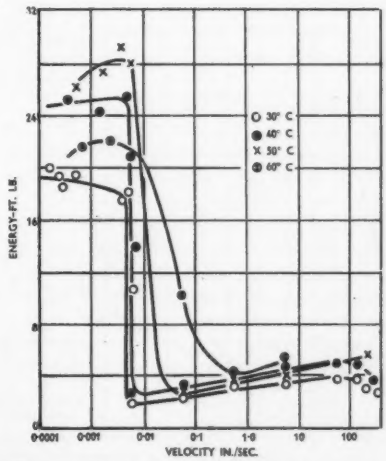
In Fig. 4 we have the results of the tensile impact tests on methyl methacrylate plotted as energy to break v. log. rate of straining. We see two distinct drops in the energy scale as we progress up the log. rate scale. Considering the 70° C. curve, it starts out on a plateau of high energy at low rates of straining and at about 0.01 in. per sec. there is a sharp drop corresponding to the maximum rate of chain-chain slipping or plastic flow. Above this rate there is a plateau of moderate energy followed by another drop which corresponds to the maximum rate of chain uncoiling. Following this drop there is another plateau of low energy which represents the amount of energy the material can absorb elastically or by bending of the bond angles.

The first drop is dependent on the relaxation rate of the bonds responsible for restraining plastic flow and the second drop on the relaxation of the bonds restraining visco-elastic response or chain uncoiling. If tests could be carried out at even higher velocities, there would be another drop at a rate comparable to the velocity of sound in the material. That is, the maximum rate of propagation of strain through the material would have been exceeded.

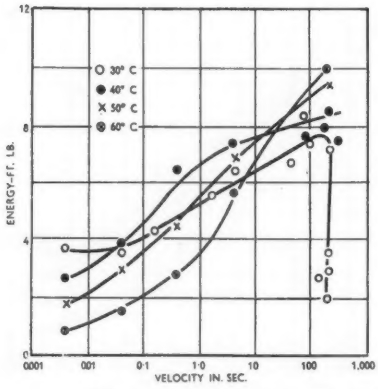
The effect of temperature on the location of the first drop is rather slight. There is only a slight general trend towards higher rates of straining with

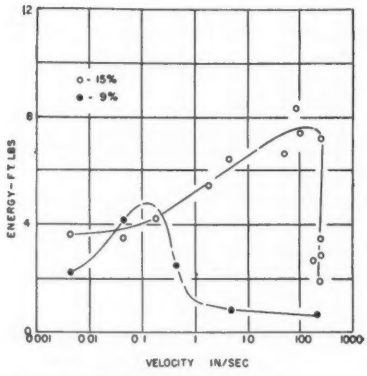






Data for rigid vinyl chloride-acetate copolymer : Fig. 5 (left), Fig. 6 (centre), Fig. 7 (right).





Data for ethyl cellulose: Fig. 8 (left) 15 per cent. plasticizer content. Fig. 9 (right) comparison of 9 per cent. and 15 per cent. plasticizer content.

higher temperatures, which is the same as saying that this internal viscosity is only slightly temperature dependent. The second drop has a very definite temperature dependence; so much so that at 30° C. it has become slower than the first drop.

Similar data for rigid vinyl chloride-acetate copolymer is shown in Figs. 5, 6 and 7. The ultimate loads follow the same trends as found in methyl methacrylate. The ultimate elongations also show the expected decrease with increased straining rate, but in this case there are distinct drops in the elongation curves at a velocity comparable to the first drop in the energy curve. This is in agreement with the principle that the first drop represents the maximum velocity of plastic flow. It was not possible to extend the test far enough on the rate of straining scale to pick up the second energy drop except on the 30° C. curve.

Many interesting problems can be studied with the technique, for example the effect of plasticizers. Does the addition of plasticizers shift the position of the drops or just raise or lower the energy plateaus? Fig. 8 shows the results obtained on a sample of ethyl cellulose containing 15% plasticizer. Again only at 30° C. was it possible to pick up the drop. Due to the high temperature dependence of this second drop, it was impossible to reach rates of straining high enough to locate the drop at higher temperatures.

For comparison, another sample of ethyl cellulose with only 9% plasticizer was tested at 30° C. The two curves are shown in Fig. 9. It is immediately apparent that the addition of plasticizer shifts the location of the drop out on the rate of straining scale and also increases the energy to break prior to the drop.

Fig. 10 shows the 30° C. curves for methyl methacrylate, rigid vinyl, the two ethyl celluloses together with data on a wood-flour filled phenolic for comparison. Since this last material does not exhibit any plastic deformation, even at very slow rates of straining, it does not show any drops in the energy vs. log. rate of straining curves, just a steady slight increase corresponding to the increase in ultimate strength. Similar data also have been found for polystyrene.

The effect of rate of straining on the tensile impact strength of nylon is shown in Fig. 11. In the velocity regions, where we would expect to find sharp drops in the energy curves, we see that there are peaks or bumps instead. Since the energy to break depends on both the amount of force required and the amount of elongation at break, these two factors must be acting in such a way as to show large amounts of energy at these rates of straining. An inspection of the load deformation curves gives us some insight into this phenomenon. In the region of the first peak the yield load is constant with the rate of straining, while the elongation at break increases slightly. This results in an increase in the energy to break. At very slow rates of straining the time under load is very long and therefore there is time to fail before reaching a high elongation. As the rate of straining is increased, the time under load decreases, and it is therefore possible to reach higher elongations before the break. Of course, as the rate of straining is still further increased, the elongation at break decreases in a manner similar to that found in methyl methacrylate and rigid vinyl due to the freezing out of the relaxation. Although

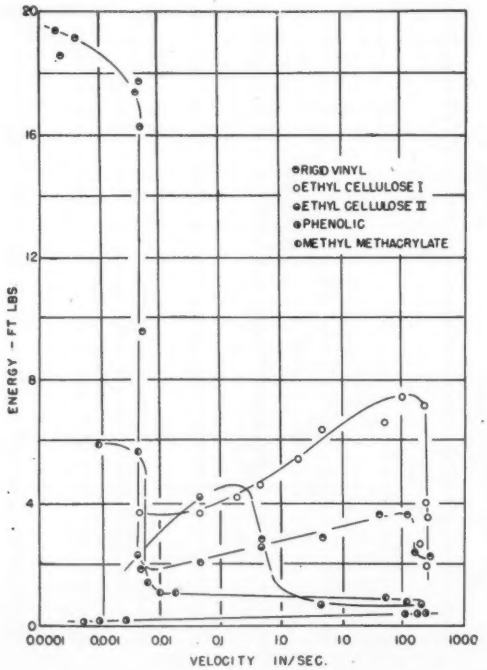
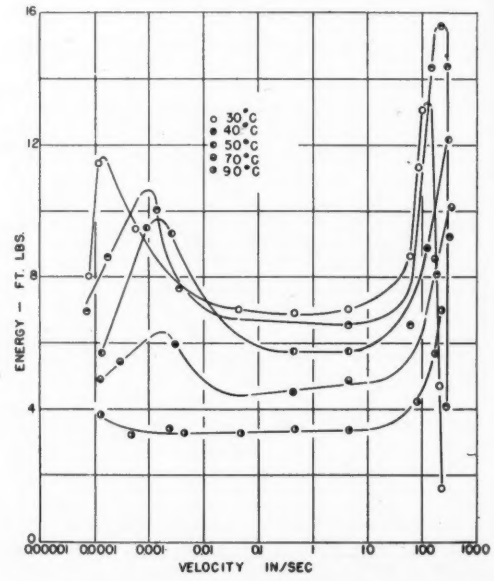


Fig. 10 (left).— Impact strengths of five common plastics as a function of velocity of impact.

Fig. 11. — Impact strengths for nylon as a function of impact velocity at several temperatures.



no data on elongation could be taken in the region of the second bump, a similar explanation seems reasonable.

Conclusions

There are many interesting conclusions which may be drawn from this study. Those which are of theoretical significance are:—

1. The yield strength increases logarithmically with the rate of loading.

2. An increase in temperature causes a change in the yield strength which is similar to that caused by a decrease in the rate of straining.

3. It is usually possible to find two distinct energy drops for thermoplastics in the velocity range covered in this study.

4. Energy drops would not be found in materials that do not exhibit plastic flow.

5. Plastic flow (chain/chain slipping) cannot take place at velocities greater than the lower critical velocity, which is determined by the first energy drop.

6. Retarded elastic deformation (chain uncoiling) cannot take place at velocities greater than the second critical velocity, which is determined by the second energy drop.

7. Only elastic deformation takes place above the second critical velocity.

A more practical application of the results leads to the following conclusions:—

8. Impact tests should be performed over a wide range of rates of straining to properly evaluate the properties of a material.

9. These impact tests should also be performed over the temperature range to be expected in any applications of the material.

10. The addition of plasticizer to the polymeric material shifts the location of the energy drops out on the rate of straining scale, and also increases the energy the material can absorb at velocities below this drop.

In general, a material must "give" with the blow if it is to have a high impact strength. This may be accomplished by: (1) having a high elastic response which would give a large energy value above the second critical velocity; (2) having either a high energy for the retarded elastic response or a very rapid retarded elastic response (which would mean a high second critical velocity), or (3) by having a rapid plastic response.

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(1) *B. Maxwell and J. P. Harrington, "Effect of Velocity on the Tensile Impact Properties of Polymethyl Methacrylate," Transactions of A.S.M.E.—Vol. 74, No. 4, May, 1952.* (2) *A. X. Schmidt and C. A. Marlies; Principles of High-Polymer Theory and Practice, McGraw Hill, New York, 1948, p. 307.* (3) *Telfair and Nason; Impact Testing of Plastics—I, Modern Plastics, Vol. 22, pp. 145-149, 1945.* (4) *British Rheologists Club; Essays in Rheology, Pitman, New York, 1947.* (5) *B. Maxwell and J. P. Harrington; Effect of Velocity on the Tensile Impact Properties of Methyl Methacrylate; Princeton University Technical Report No. 19A; Nov. 1950.* (6) *B. Maxwell and L. F. Rahm; Impact Testing of Plastics, Elimination of the Toss Factor; A.S.T.M. Bulletin, No. 161, p. 44, Oct. 1949.*

International Standards Organization

We have received from the British Standards Organization, 24 Victoria Street, London, S.W.1 (the British representatives of I.S.O.), a report of the meeting of Technical Committee 61, Plastics, held at Turin last October.

TECHNICAL Committee 61, Plastics, of the International Organization for Standardization, of which the U.S.A. (American Standards Association) are the Secretariat, held its first meeting in New York on September 18 and 19, 1951. The second meeting was held in Turin on October 2, 3 and 4, 1952, and was attended by delegations from Belgium, France, Germany, Italy, the Netherlands, Sweden, Switzerland, the United Kingdom and the U.S.A., together with observers representing the International Union of Pure and Applied Chemistry. The United Kingdom delegation, nominated by the Plastics Industry Standards Committee of the British Standards Institution, were G. Dring (leader), H. Warburton Hall, R. Hayes, A. A. Tomkins, C. Wainwright, P. Welford and A. H. Willbourn.

The arrangements for the meeting in Turin were made by the Italian Standards Organization (U.N.I.) under their director, Dr. Rossi. The chairman was Dr. Kline (U.S.A.), with Prof. Muzzoli (Italy) as co-chairman.

The meetings were held in the meeting room of the Unione Industriale, 20 Via Massena, Turin. At the opening plenary session the delegates were welcomed by Mr. St. Leger, the general secretary of I.S.O., and meetings of the Working Groups followed. The final meeting was a second plenary session.

The five Working Groups were appointed at the first meeting in 1951 and met at Turin under the chairmanship of the designated secretariat country of each. The Working Group on physical chemical properties (Secretariat, United Kingdom) dealt with the determination of water absorption; the Working Group on strength properties (Secretariat, the Netherlands) with the determination of flexural properties of rigid plastics; the Working Group on standard laboratory atmospheres and conditioning procedures (Secretariat, Sweden) with fixing the temperature, relative humidity and time for conditioning test pieces; the Working Group on thermal properties (Secretariat, U.S.A.) with the determination of the temperature at which a stressed beam was deflected an arbitrary amount (based on the A.S.T.M. heat-distortion method); and the Working Group on equivalent terms (Secretariat, France) with the preparation, in English and French, of a list of equivalent terms used in the plastics industry.

The delegates were impressed by the substantial measure of agreement which was reached during the meetings and were charmed with the warmth of the welcome they received and the hospitality they were given by their Italian hosts, from the civic welcome by the Lord Mayor at the opening of the Conference to the delightful banquet presided over by Count Camerana with which the proceedings closed.

VINYL-TYPE POLYMERS FOR SURFACE COATINGS (*Continued from page 87*)

being done. With the new solvent plants now producing, it is possible to prepare paints from British resins, solvents and pigments, the value of imported crude raw material for a gallon of finished paint being very much lower than that required when it is made from imported oils and resins.

For this reason, as well as the special technical qualities of the finishes produced from them, development of the vinyl polymers is certain to continue rapidly. The potential is already great, and will increase as new monomers become commercially available. Study of the patent literature reveals how much work is being carried out, and indicates the wide variety of combinations possible. The esters of maleic and other unsaturated acids, for example, have received much attention, especially in copolymers with styrene and other materials.

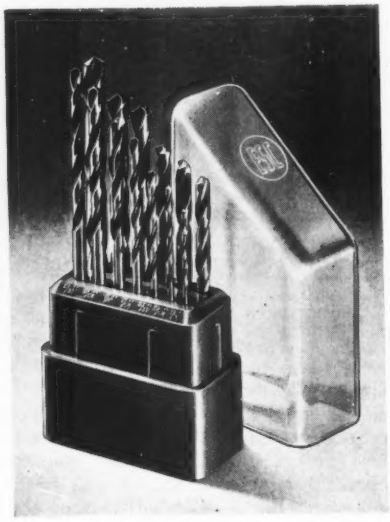
The allyl esters of dibasic acids, such as diallyl phthalate, are of particular interest. These form addition polymers, with the added property that these can be of the thermosetting type, since each molecule of ester contains two unsaturated linkages. It is thus possible to take a film of the liquid monomer and with the aid of suitable catalysts, polymerize it to a hard, tough, resinous coating, so forming a solventless varnish. There is no doubt that there will be spectacular developments on these lines, since the ultimate varnish must be one containing no solvent, but utilizing the whole of the liquid medium in film formation, and so yielding very high film thicknesses at one application.

New Productions

"Courlene" protective overalls.

Protective Clothing

We published in January details of a new material produced by Courtaulds, Ltd., called "Courlene." Woven from polythene yarn, the material offers unique possibilities in the field of protective clothing, particularly protection against the splashing of corrosive liquids in chemical plants. We have received a photograph, reproduced on the left, from Courtaulds, Ltd., showing a suit of overalls made from this material. This new fabric has the advantage that it will permit the passage of air and is therefore more comfortable to work in than ordinary sheet material.



Drill pack.

Handy New Drill Pack

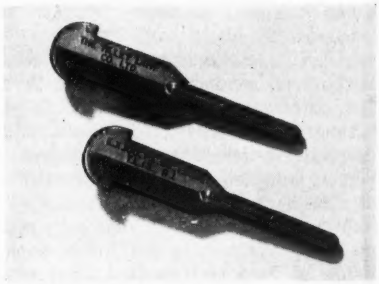
Designed for the tool-room, workshop, garage and handyman, a sturdy plastic case holding thirteen Easicut high-performance twist drills in popular sizes ranging from $\frac{1}{16}$ in. to $\frac{1}{4}$ in. diameter is now being marketed by the English Steel Corporation, Ltd., of Openshaw, Manchester. The drills, held upright in a red plastic base with the sizes clearly embossed on the surface, are kept free from dust and dirt by a push-fit transparent cover.

The case, made by Lorival Plastics, of Little Lever, near Bolton, Lancs, is produced in three parts. The drill holder and base are compression moulded in tough phenolic material, whilst the transparent cover is injection moulded in clear polystyrene.

Moulded Dipsticks

These dipsticks, moulded for The Tilley Lamp Co., Ltd., by Lorival Plastics, of Little Lever, near Bolton, Lancs, are designed to show users of all the lamps in the Tilley range exactly how much paraffin they have left and when the correct level has been reached whilst re-filling.

Moulded in dark green, general-purpose phenolic material, they are produced from a multi-cavity type mould incorporating automatic split ejection and opening. The barrel surface of the dipstick is slightly matted so that the oil level can be clearly seen.



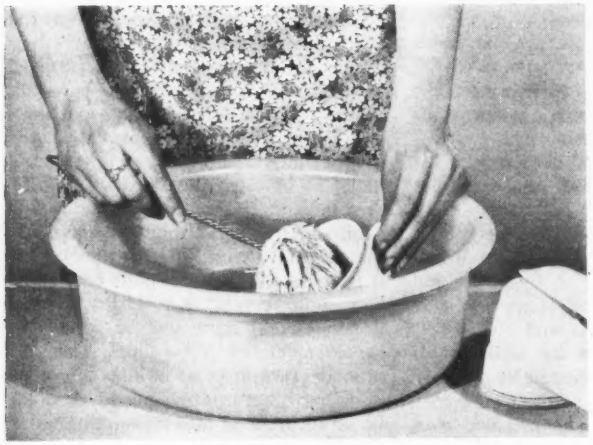
Dipsticks for lamps.

Polythene Bowl

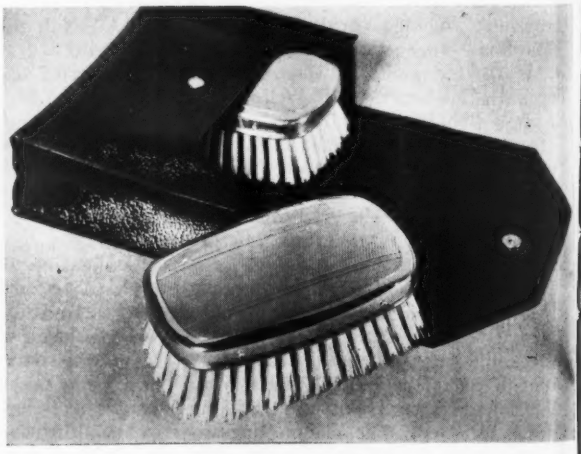
Illustrated is the polythene kitchen bowl marketed by E. K. Cole, Ltd., and intended for dish washing, food mixing and general domestic use. Immune from staining, cracking, chipping and discoloration, it also reduces the risk of breakage to crockery washed in it, and cannot cause damage to sinks and draining boards. The bowl is injection moulded in one piece and will be produced in two sizes, 14 in. diameter and 11¾ in. diameter. This type of completely unbreakable bowl has already found wide acceptance by the housewife.

Hairbrushes

Illustrated below are new military hairbrushes manufactured by Halex, Ltd. The backs are of polystyrene, having been metallized to give a very attractive finish. The silver-like finish will not scratch or wear. The brushes are packed in blue or brown p.v.c. cases.



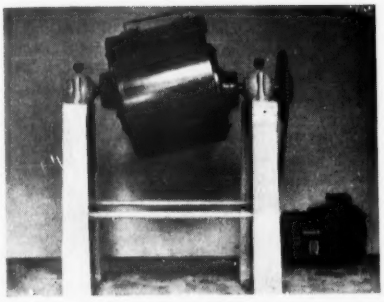
Polythene kitchen bowl.



Military hairbrushes.

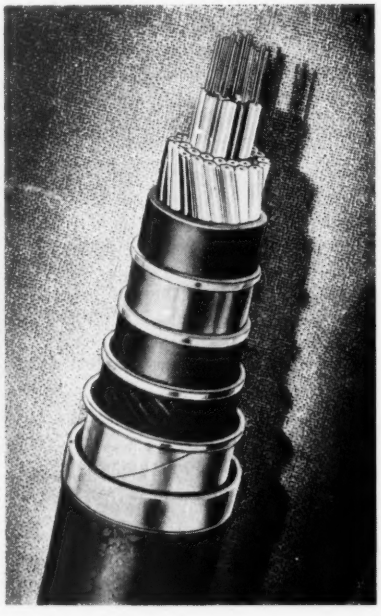
PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



BARREL POLISHING.—Fox Chemical Engineering Works, Ltd., of Willesden, London, N.W.10, have issued a booklet dealing with the polymotion machine which, it is claimed, sets a new high standard for finishing operations. The interior walls are rubber lined and the machines are designed on the general principle of covered inner surfaces and eccentric rotary movement. By this method smooth surfaces are obtained and a high degree of polish.

FIRST PLASTIC TELEPHONE CABLES IN DENMARK.—Two cables, each about 20 miles long, have been laid between Copenhagen and Roskilde. Manufactured by the Telegraph Construction and Maintenance Co., Ltd., of Greenwich, London, S.E.10, they are the subject of an interesting booklet published by this company. The copper conductors are completely insulated with a solid dielectric, Telcothene. The material is unaffected by water, and the insulated conductors therefore require no lead covering—merely a tubular Telcothene sheath. The cables are remarkably light in weight, which makes installation correspondingly easy.



MONSANTO CHEMICALS, LTD., announces the creation of a new division, the overseas division, which will co-ordinate the operations of all of Monsanto's interests outside the United States, including the export sales of Monsanto Chemical Co. The head of the new division will be Mr. Edward O'Neal, Jr., chairman of Monsanto Chemicals, Ltd.

DUST CONTROL.—Catalogue No. 25, issued by Dallow, Lambert and Co., Ltd., Spalding Street, Leicester, gives details of various machines for the control and disposal of industrial dust. In addition, information is given concerning the various accessories, including polishing hoods, suction fittings, and inlet adapters.

SAFETY EQUIPMENT.—We have received booklet SB/1, issued by Industrial Guarding Equipment, Ltd., Mill Works, Alvechurch, Birmingham, which gives details of guards, gloves, goggles, footwear, matting and wire-work manufactured by this company.

RESINOID AND MICA PRODUCTS, LTD.—We have received two leaflets, the first dealing with closures for the packaging industry and the second describing the wide range of processes employed by this company in the manufacture of plastics components. The latter booklet contains a useful chart showing the physical properties of many of the commonly used plastics materials.

PLASTICS PRODUCTION IN THE U.S.A.—Figures reported by the Society of the Plastic Industry Inc., indicate that the American industry again achieved a record year in 1952. Production of raw materials was up by approximately 168,592,000 lbs., at 2,600,000,000 lbs. It is estimated that there are 500 companies comprising the plastics industry, employing a total of 200,000 people. With 60 per cent. of all plastics production going into industrial and military products, the industry is substantially dependent on Government purchases. The continued increase in consumption of plastics products by industry, however, is expected to offset much of the reduction in Government spending.

AMERICAN REINFORCED PLASTICS.—The Society of the Plastic Industry Inc., announce a production increase of 40 per cent. in 1952 and anticipate a further 40 per cent. increase this year. Employing considerable quantities of glass fibre bonded with polyester resins, reinforced plastics are now being used in America in refrigerator components, luggage, furniture, fuel oil tanks and in many other applications.

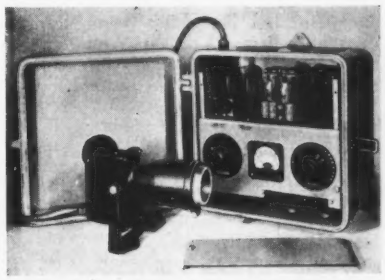
L. LIGHT AND CO., LTD.—We have received the 1953 edition of "Light's List of Organic Chemicals," which mentions over 2,300 items. Copies of this very useful list can be obtained from the publishers at Poyle Trading Estate, Colnbrook, near Slough, Bucks.

IMPERIAL CHEMICAL INDUSTRIES, LTD.—The leaflet S.C. 700 gives details of Polymon Blue GS, a modified form of Monastral Fast Blue G specially designed and controlled for colouring plastics moulding powders. It is non-migrating and non-bleeding from plastics, has good heat stability and exceilent light fastness. Particulars of its application to polythene, cellulose acetate, cellulose nitrate, polystyrene urea formaldehyde and phenol formaldehyde are given.

GLYCO PRODUCTS CO. INC.—In view of the application of moulded nylon parts as engineering materials in the form of gears, cams, etc., the problem arises of residual stresses set up during the moulding process and shrinkage after moulding. A procedure for dealing with this involves heat-treated nylon moulded parts by immersion in a suitable heat-transfer medium at a temperature of approximately 350 degrees F. Glycowax S-932, a synthetic wax, is employed for this purpose, since it is stable over the heat range required, does not attack nylon, and has a high flash point. Glycowax is manufactured by Glyco Products Co. Inc., Brooklyn 2, New York, U.S.A., from whom samples and detailed information can be obtained.

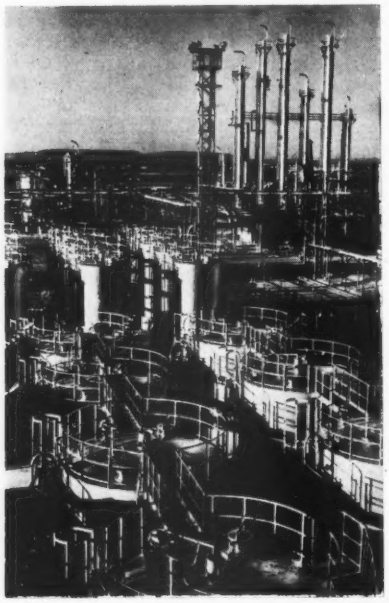
RUBBER TRADE DIRECTORY OF GREAT BRITAIN.—Published by Maclaren and Sons, Ltd., Stafford House, Norfolk Street, London, W.C.2, the 1952-53 edition of the directory contains 856 pages of information valuable to any organization connected with the rubber industry. Compiled by the editorial staff of the India-Rubber Journal, the price is three guineas post free.

ELECTRONIC CONTROL EQUIPMENT.—Designed for the automatic control of resistance welding, R.F. and induction heating, and many other applications throughout the engineering industry, the pyrometer controller manufactured by Elcontrol, Ltd., 10, Wyndham Place, London, W.1, is actuated photo-electrically. It responds to the light emitted by the heated body and gives positive relay action when the desired temperature is reached, thus cutting off the heating current and/or



operating any desired electro-mechanism or signal. As will be seen from the illustration, the installation is compact and is accurate within 5 degrees at 1,000 degrees C. We have also received details of the electronic process timers manufactured by this company employed for the control of fluid valves in chemical manufacture, plastics moulding, etc.

OPENING OF NEW PETROLEUM CHEMICAL PLANT IN FRANCE.—Calculated to save as much as U.S. $700,000 per year in foreign exchange, Shell-St. Gobain's new petroleum-based solvents plant at Berre, near Marseilles, was officially opened on January 29, 1953. Hitherto France has had to import a large proportion of her solvents requirements from the U.S.A. Now, however, this new plant, the first of its kind in France, with an annual production of 7,500 tons of acetone and mixed solvents, will enable imports to be cut substantially, with consequent saving in foreign exchange.



By means of techniques similar to those employed for the same purpose in British and American petroleum chemical plants, tonnages of the individual chemicals will be varied to suit the needs of a large number of important industries such as textiles, plastics, paint and lacquer, perfumery and cosmetics, etc. Raw material for manufacture will be gas—propylene—derived from petroleum and obtained from the nearby refinery of Shell-Berre. Jointly owned by Shell and the Société de Saint-Gobain, and begun in July, 1951, the new £2m. plant was completed last November, when the first installation came on stream. With the exception of some of the special equipment, all material for the plant was manufactured in France, and French labour and workmanship were employed throughout.

UTRECHT INTERNATIONAL FAIR.—The 60th International Fair will open at Utrecht on March 17, and part will be housed in a new exhibition hall, the largest on the continent of Europe.

SCOTT BADER AND CO., LTD., announce that Dr. J. O. Cutter has joined the company as chief chemist.

Dr. Cutter has held an important position for many years at the Paint Research Station, Teddington. Since the war he was active in other industries and he has retained and extended his interest and knowledge of the paint industry during the whole of this period, and is looking forward to seeing again many old friends.

CHEMICAL PLANT EXHIBITION.—The first to be held since the war, the Exhibition covers a broad chemical engineering field, including complete process plant designers and contractors, makers of plant for performing unit operations, specialist fabricators of plant in a wide range of materials for construction and makers of ancillary equipment, such as instruments, valves, pumps, packings and jointing. The Exhibition, which will take place in September, from the 3rd to 17th, will form a section of the Engineering, Marine and Welding Exhibition organized by F. W. Bridges and Co., Ltd.

BAKELITE, LTD.—The annual general meeting will be held on April 23, 1953. The preliminary announcement states that the group profits for the year ended December 31, 1952, amount to £562,660 after all charges except taxation. This compares with £687,131 for the previous year. The profits available for appropriation are £241,360, as against £320,341 for 1951.

Mr. A. J. Potter.

COMPRA PLASTICS, LTD.—Mr. A. J. Potter has resigned from his position of sales manager of Cosmocord, Ltd., in order to devote his full attention to the sales and products of Compra Plastics, Ltd., of which he is a director.

SYNTHETIC RUBBER.—The Scottish Council (Development in Industry) is discussing the possibility of establishing a synthetic rubber plant in Scotland. It is understood that the Dunlop Rubber Co., is concerned, among others, in the discussions. A year ago Sir Clive Baillieu, created a baron in the New Year Honours List, indicated that Dunlop would continue to co-operate with practical measures towards the establishment of synthetic rubber production in the U.K.

WITCO CHEMICAL COMPANY has moved to larger and more modern headquarters in the new building at 260, Madison Avenue, New York 16, New York.

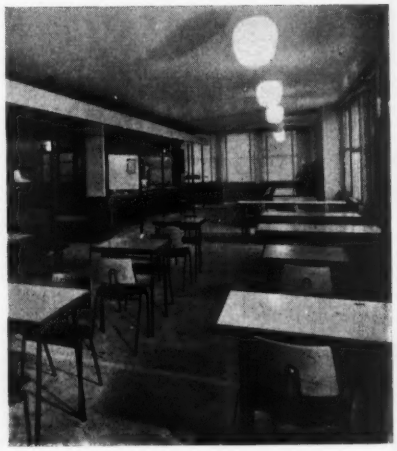
MINISTRY OF FUEL AND POWER.—The Information Branch of the Ministry of Fuel and Power has been transferred to Thames House South, Millbank, S.W.1. The telephone number remains Abbey 7000.

Mr. J. M. Lassen.

BAKELITE, LTD., announce the following appointments: Mr. Pattman, who has been made purchasing manager, joined the Damard Lacquer Co. in 1921. He has paid a number of visits to India, where he has taken an active part in establishing Hyderabad Laminated Products, Ltd., who are pioneers in the manufacture of laminated sheet in that part of the world.

Mr. Lassen, who has been appointed sales manager for Vybak p.v.c. materials, joined the company as an engineering trainee in 1940, before serving with the Royal Navy. Returning in 1946, he was appointed to the new Vybak Thermoplastics Unit and has since been concerned with developing sales of these materials.

TIME AND LIFE BUILDING.—Recently opened, the Time and Life Building in New Bond Street contains a beautifully designed and decorated cafeteria designed by Sir Hugh Casson in co-operation with Neville Condor, Patience Clifford and Robin Dunn. The tables are built by Andrew A. Pegram and have surfaces of blue stardust Warerite plastics, contributing to the colour scheme and are of functional value because of their resistance to staining and the ease with which they can be kept clean. The cafeteria is shown below.



THE TELEGRAPH CONSTRUCTION AND MAINTENANCE CO., LTD.—The appointment has been announced of Mr. A. D. Lidderdale, A.M.I.Mech.E., to the position of chief mechanical engineer. Mr. Lidderdale was previously with the A.P.V. Co., Ltd.

FLOOD DISASTER.—Following the disastrous floods of the week-end starting January 31, the board of directors of E. K. Cole, Ltd., decided to donate £1,000 to the distress fund opened for victims of the flood. The illustration shows Mr. A. W. Martin, M.B.E., technical director; Mr. J. Cobishley, director and chief accountant, and Mr. F. Allen, works director, handing the cheque to the Mayor of Southend, Mr. J. E. Longman, J.P.

Presentation of Ekco cheque to Mr. Longman.

PRODUCTIVITY REPORT.—The following are the arrangements for the Birmingham and Manchester meetings to discuss the Moulders' Productivity Report: Birmingham: 6.30 p.m. on March 25, in the Assembly Hall at the Birmingham Chamber of Commerce, 95 New Street, Birmingham. Tickets may be obtained from Mr. D. H. Balfry, Industrial Mouldings (Warwick) Ltd., Emscote, Warwick. Manchester: 2 p.m. on March 26, in the Engineers' Club, Albert Square, Manchester. Tickets may be obtained from the Federation. It should be stressed that these meetings are open to all interested in the industry and not confined to Members of the Federation.

GERMAN STANDARDS.—The Plastics Technical Committee of the German Standards Organization (Deutsche Normenausschuss, Berlin, W.15, Uhlandstrasse 175) has published a leaflet containing a list of all published DIN standards relating to plastics materials and products. Details are also given of draft standards and various books relating to standards and testing methods.

DE LA RUE, LTD.—One of the heaviest advertising campaigns that has ever supported any product sold through ironmongers and hardware stores will shortly introduce to the public Formica laminated plastic in cut panel form. Previously Formica has been available only in complete furniture. Now for the first time the material may be obtained at moderate cost for home application on existing surfaces. Panel sizes are 3 ft. by 2 ft., 4 ft. by 2¼ ft., 4½ ft. by 2 ft., and 4 ft. by 3 ft., to correspond with average-sized tables. Patterns are the popular Linette range in buff, green, blue, grey and pink. Formica panels are available either as a $\frac{1}{16}$-in. sheet suitable for fixing to tables with smooth, level, unmarked surfaces or ready-bonded to ply or blockboard for older, worn surfaces, panels of $\frac{1}{5}$-in. retail at 33s., 49s. 4d. and 66s. Bonded panels cost rather more. Full details, including the recommended adhesive, instructions, leaflet, and full colour showcard may be obtained from the official distributors of the manufacturers, Thomas De La Rue and Co., Ltd.

MR. E. G. FISHER, M.P.S., one of Britain's leading experts in thermoplastics, who has written and lectured extensively on the subject in this country and abroad, has been appointed technical consultant in thermoplastics to the Toa Gosei Chemical Industry Co., Ltd., Tokyo.

ACCIDENTS IN THE RUBBER INDUSTRY.—A report published by the National Joint Industrial Council for the Rubber Manufacturing Industry, Royal Exchange, Cross Street, Manchester, entitled "Studies of Accidents in the Rubber Industry," will be of interest to the plastics industry. The report is full of valuable information dealing with problems common to both the plastics and rubber industries, and includes information on presses, mills, calenders and buffing machines.

POLYESTER RESINS.—We have received from Bakelite, Ltd., a provisional information bulletin dealing with the physical properties, treating and curing operations for a number of the series of Bakelite polyester materials. The bulletin also contains information on the accelerators for polyester resins manufactured by Bakelite, Ltd.

GRIFFIN AND TATLOCK, LTD.—We have received catalogue No. 66CR dealing with chemicals and reagents for use in research, analysis, education and industry. This catalogue is handsomely printed and well classified.

SIDNEY-BARTON, LTD., announce that their address is now Broadway Chambers, 7 Ludgate Broadway, London, E.C.4. Telephone, City 5391.

BRITISH INDUSTRIAL PLASTICS.—Announce the appointment of Mr. Ernest Jones (Northern area manager) to the position of sales manager for moulding powders. Mr. Stephen Gibbs has been appointed sales manager for resins. Both appointments took effect as from February 1, 1953.

NIPPON SYNTHETIC RESIN INDUSTRIES, LTD., announces that it has resumed its former name of Sumitomo Synthetic Resin Industries, Ltd., Osaka Building, 1, Soze-Cho, Kita-Ku, Osaka, Japan.

FORTHCOMING MEETINGS

Mar. 16.—"Silicones in Plastics and in the Foundry," J. H. E. Jeffes. Plastics Institute, Midland Section, Grand Hotel, Leicester.

Mar. 18.—Film Show. Plastics, Institute Scottish Section, Institution of Engineers and Shipbuilders in Scotland, Small Hall, Glasgow, 7.30 p.m.

Mar. 18.—"Epoxide Resins in the Foundry," W. J. Marmion, B.A. Plastics Institute, Southern Section, Polygon Hotel, Southampton, 7.30 p.m.

Mar. 19.—"The Effect of Some Physical Properties of Nitrocellulose on Lacquer Performance," W. A. Caldwell and J. Creasy. Oil and Colour Chemists' Association, London Section, Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London, W.1, 7.0 p.m.

Mar. 20.—"Synthetic Resins in the Foundry," M. C. Dixon and R. S. Bushnell. Plastics Institute, Midlands Section, James Watt Memorial Institute, Great Charles Street, Birmingham, 3.

Mar. 25.—"Injection Moulding and Present Day Trends," J. S. Walker. Plastics Institute, Western Section, The Technical College, Gloucester, 6.30 p.m.

Mar. 25.—"Colour Appreciation and Colour Blindness," Dr. V. G. Jolly, B.Sc., Ph.D. Plastics Institute, North-Eastern Section, Newcastle, with Oil and Colour Chemists' Association.

Mar. 27.—Works Visit to Fibreglass, Ltd., St. Helens, afternoon. "The Use of Glass Fibres with Plastics," A. M. Dobson, B.Sc., A.Inst.P., evening. Plastics Institute, North - Western Section.

Mar. 27.—Dinner/Dance, Plastics Institute, Midlands Section. Chadwick Manor Hotel, Knowle.

Mar. 30-Apr. 1.—Technical Trade Exhibition, Oil and Colour Chemists' Association, London Section, Borough Polytechnic, London, S.E.1. Three days.

Apr. 7.—"Recent Advances in the Ionic Reactions of Rubber," Dr. M. Gordon and J. S. Taylor. Society of Chemical Industry, Plastics and Polymer Group. Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London, W.1, 6.30 p.m.

Apr. 8.—"Recent Developments in Measuring the Size and Shape of Macro Molecules," Professor H. W. Melville, D.Sc., F.R.S. Plastics Institute, South Wales and Monmouthshire Section, Cardiff Technical College.

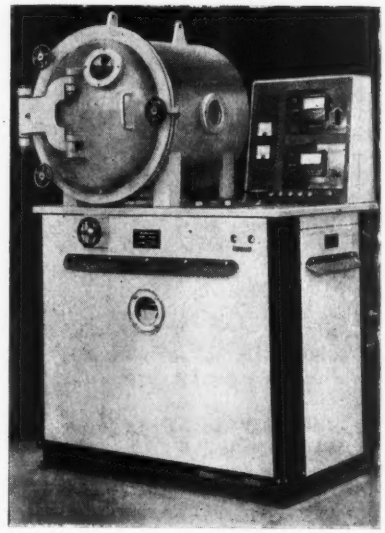
Machines for the Industry

Edwards Vacuum Coating Plant

VACUUM coating is a revolutionary new technique for the deposition of thin films of metals, and certain of their compounds, on metallic or non-metallic surfaces. This new coating technique is a developed commercial process with an ever-increasing impact on industrial finishing. W. Edwards and Co. (London), Ltd., Worsley Bridge Road, London, S.E.26, produce several units for this process, one of which is described here.

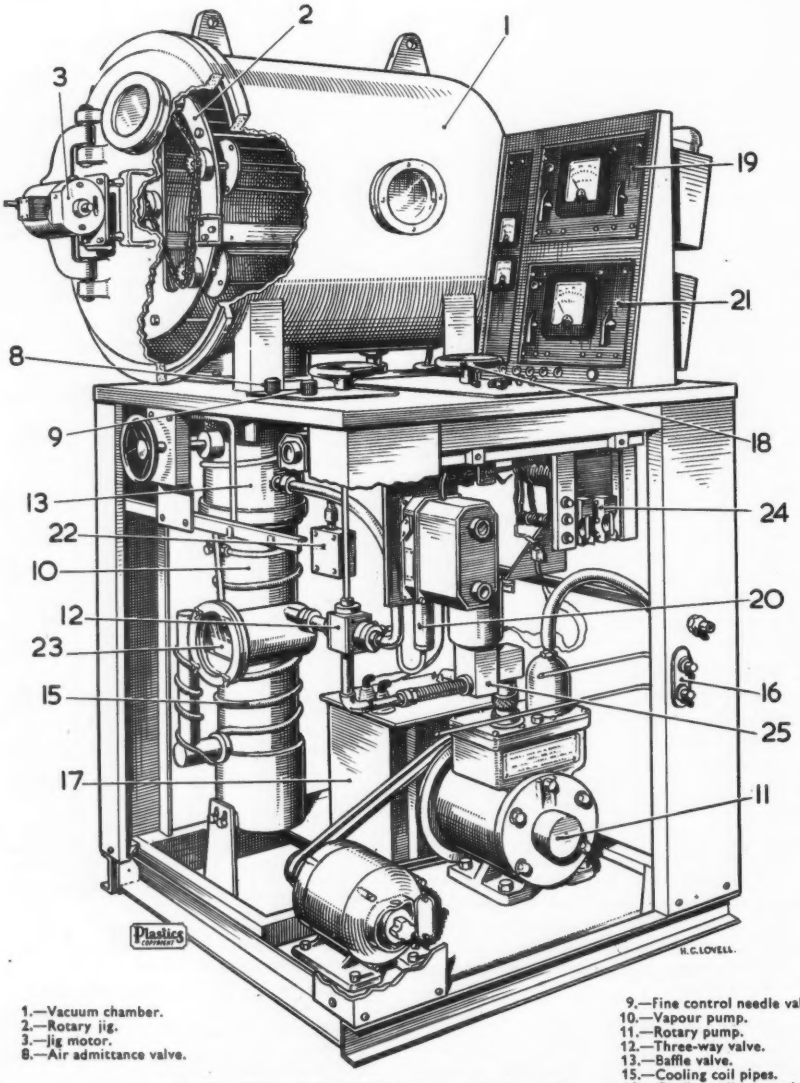
Edwards Model 24E Vacuum Coating Plant has been designed especially for the bulk metallizing of plastics. Plastics materials that have been successfully metal-coated include cellulose acetate, polymethyl methacrylate, polystyrene and thermosetting mouldings. The deposition of most metals may be undertaken, but aluminium is the choice for most decorative purposes. Aluminium coating in conjunction with simple dip-lacquering and tinted lacquers can give beautiful mirror surfaces and coloured effects. Arresting three-dimensional effects are obtained on acrylic and polystyrene mouldings by back-coating and tint-lacquering. Above all, the economies of the process enable it to compete successfully with existing methods.

The evaporative vacuum coating technique employed in the Model 24E



involves the electrical melting and vaporizing of the metal, at a pressure of 10^{-4} mm. of mercury or lower, and the subsequent condensation of the vapour on the surface to be coated. Vapour molecules leaving the source have few or no collisions with air molecules and hence travel in characteristic straight lines; their paths can be compared to light rays, any part of the work "visible" from the vapour source will be coated.

Correctly designed jigs in the vacuum chamber, to hold the work in the right position relative to the evaporative source, play an important part in obtaining successful results. There are two standard jigs, designed for the optimum coating of plastic articles in the Model 24E vacuum chamber. A static jig provides for the coating of plane surfaces. A rotary jig is used where intricately-shaped mouldings or other objects are to have all their surfaces coated; the jig being revolved as evaporation proceeds and being so designed that all surfaces of the work are presented at right-angles to the vapour source at regular intervals throughout the process. These standard jigs cover as many applications as possible but bulk production of many specific types of work will, of course, be facilitated by designing a special jig for them. Additional effects can be given by masking certain portions



1.—Vacuum chamber.
2.—Rotary jig.
3.—Jig motor.
8.—Air admittance valve.
9.—Fine control needle valve.
10.—Vapour pump.
11.—Rotary pump.
12.—Three-way valve.
13.—Baffle valve.
15.—Cooling coil pipes.
16.—Cooling coil connections.
17.—High voltage transformer.
18.—Variac transformer control.
19.—Pirani-type gauge.
20.—Pirani gauge head.
21.—Cold cathode ionization gauge.
22.—Vacuum safety switch.
23.—Vapour pump moisture trap.
24.—Fuses.
25.—Magnetic safety valve.

Fig. 1.—Edwards Model 24E vacuum coating unit.

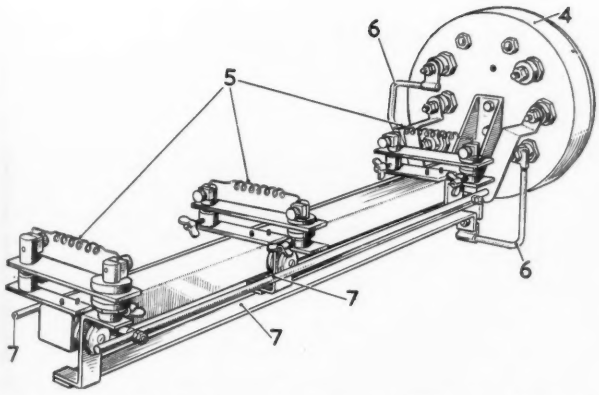


Fig. 2 (left).—Details of the filament holder.
4.—Electrode mounting block.
5.—Filaments.
6.—Holder connections.
7.—Discharge electrodes.

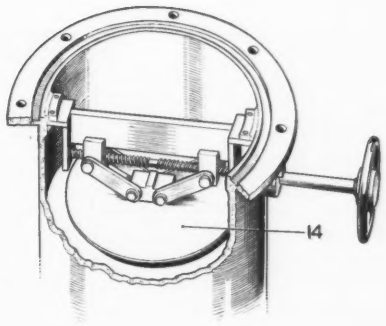


Fig. 3 (right).—Details of baffle valve.
14.—Valve plate.

of the work, and by successive coatings with different positions of masks and different deposited metals.

The deposited film is built up molecule by molecule and the finished coating exactly reproduces the surface beneath—thus a highly polished base will become a gleaming metal surface without any further finishing processes. Unpolished surfaces can be given a specular surface before coating by simple dip lacquering. A similar lacquering after metallization is used to protect the coating, if necessary; for colour effects a tinted lacquer is employed, especially effective when combined with a lustrous coating of neutral-coloured aluminium.

The drawing (Fig. 1) shows the main features of Edwards Model 24E. The vacuum chamber (1) is 24 in. diameter by 24 in. long and is shown with a standard rotary jig (2) which is comprised of five vanes each with three arms for holding the work to be metallized. The vanes are rotated by a $\frac{1}{6}$ h.p. electric motor (3) fitted to the chamber door, the drive being taken into the chamber by a special rotary vacuum seal.

In the centre of the chamber is the filament holder—also shown by the detail drawing (Fig. 2). The filament holder is supported from the end of the vacuum chamber and three filaments (5) are provided. Filaments vary according to the metal in use. For vaporizing aluminium, for example, the appropriate filament is a spiral of tungsten wire inside which the pieces of aluminium are supported. Electricity is supplied by the holder connections (6) via electrodes mounted on a block at the end of the chamber (4). Perfect cleanliness is of extreme importance in vacuum coating and, in addition to cleaning before being put into the vacuum chamber, the work is subjected to a powerful ionic bombardment just before metallization. The discharge is produced by the electrodes (7) mounted on the filament holder with the necessary connection to the electrode block.

Chamber equipment is completed by an air-admittance valve (8) and a fine control needle valve (9) for the adjustment of chamber pressure needed to produce effective ionic bombardment.

The Pumping System

In order to gain the high vacuum (10^{-4} mm. of mercury or below) required for effective coating, ample pumping capacity is provided—the high speed of the pumps ensuring quick evacuation (10-12 minutes from atmospheric pressure to operational pressure) and hence rapid production cycles. A vapour pump (10) is backed by a rotary pump (11). The vapour pump is an essential for high pumping speed at low pressure, the pumping agent consisting of powerful oil vapour jets directed downwards; air molecules from the vacuum system above the vapour pump diffuse into the jets and are carried downwards to be drawn off from the base of the pump by the rotary pump.

A three-way valve (12) is provided in the line between the two pumps. This can be used for isolation, connecting the vapour and rotary pumps, or connecting the rotary pump only direct to the vacuum chamber. This latter feature—a by-pass line—is necessary so that the rotary pump can evacuate the chamber down to a pressure where the vapour pump can operate and take over. This three-way valve automatically provides for the correct sequence of events when operating the vapour pump and is an important aid to the semi-skilled operator for whom the unit is designed.

The vapour pump (10) is connected to the vacuum chamber (1) via a baffle-valve (13), also shown in a separate detail drawing (Fig. 3). For optimum pumping at low pressures the valve plate (14) and body are of large diameter. The plate seats on an elastomer seal to isolate the vapour pump during pumping via the by-pass line. Complete isolation of the vapour pump in this manner is an operational advantage as the pump may be kept warm ready for instant use. A method previously used involved evacuation from atmospheric pressure via the vapour pump; the heated oil in the latter had to cool down before the vacuum chamber could be opened, and subsequently warmed up again, with considerable loss of time. The valve plate (14) rises vertically and in the open position acts as a baffle, any molecules of pump oil vapour attempting to reach the vacuum chamber are deflected on to the cool walls of the valve where they condense, the liquid running back into the pump once more.

Both the vapour pump (10) and the baffle-valve are water-cooled by the coil pipes (15), the inlet and outlet riffled connections being on the right hand side of the plant (16).

To prevent the possibility of water vapour contaminating the rotary pump oil—leading to deterioration of performance—a moisture trap (23) is provided, the tray being filled with desiccant—phosphorus pentoxide. Moisture entering the oil during preliminary evacuation of the chamber is absorbed by this desiccant during subsequent vapour pumping.

Electrical Equipment

The plant takes 400-440 V., 3 phase current with neutral mains supply. In addition to the operation of the motors, gauges, etc., two services are required in the vacuum chamber. For the evaporating source a transformer gives a secondary supply of 20V. at 75 amp. (150 amp. for short periods). A second transformer (17) supplies 5,500 V. open circuit or 3,300 V., 500 mA., on load for ionic bombardment. Both services are controlled from the same " Variac " (18) as they are never required together. All circuits are adequately fused (24).

Two vacuum gauges are included in the plant. A Pirani-type gauge (19) has its gauge head (20) in the backing-line between the rotary and the vapour pump. A Philips cold-cathode ionization gauge (21) indicates chamber pressure. The precise knowledge of conditions in the chamber given by the Philips gauge is of the greatest assistance in obtaining perfect coatings. The Pirani-type gauge, as well as aiding correct operation of the

Continued on page 100)

British Plastics Federation

ANNUAL REPORT, 1952

THE Annual General Meeting of the British Plastics Federation will be held at 2.30 p.m. on Wednesday, March 18, 1953, in the offices of the Federation, 47-48 Piccadilly, London, W.1.

The Report records with regret the deaths of Major Stanley M. Mohr and Mr. L. G. Chaffey, both prominent in the activities of the Federation.

Information

The Information Bureau is being increasingly made use of by members and others, over 5,000 inquiries having been dealt with during the year. The inquiries demonstrate the growing realization that plastics may be able to supply a need which cannot be met by traditional materials. The report points out, however, that the Council believes that many members still do not make as much use of the Bureau as they might. The circulation of the Abstracts is steadily growing.

Technical Work

The Report details the technical work that has been carried out. Close contact has been maintained with the International Standards Organization Committee on plastics through the Plastics Industry Standards Committee of the British Standards Institution. Work has also been continued in the use of adhesives joinery, the preparation of test data on p.v.c. sheet, the preparation of a specification for Standard Hydrant Plates and the preparation of a surface coating resin index.

A Sub-committee of the Main Technical Committee has been formed to prepare a section on plastics for ultimate inclusion in the packaging code to be prepared by the British Standards Institution.

In the field of specification, the Federation has continued to be represented on a large number of B.S.I. committees and the programme has included work on a number of draft specifications by technical committees of the Federation.

During the year contact has been maintained with the Forest Products Research Laboratory, with the Admiralty, the Fire Protection Association and the Society of British Aircraft Constructors.

Discussion

The moulders discussion group has held two discussion group conferences for Works Managers and Technical Representatives, the first at Harrogate in April and the second in London in October when new developments for moulding powders were discussed.

The Report records the appreciation of the Federation, for the co-operation and support of the many members who allow representatives of their technical staff to serve on the many technical committees at work within the framework of the Federation.

The Report mentions the work of the Productivity Team which went to the U.S. in 1952.

Publicity has been increased by the appointment of a Press Officer, Mr. Andrew Reid, which has resulted in closer contact with the National and Trade Press and other news channels. The report states that many members have already sent the Press Officer information with regard to their activities and hopes that more members will do so in the future.

Mr. C. S. Dingley, Chairman, 1952-53.

A record number of 27 member firms exhibited on the combined stand of the Federation at Earls Court at the 1952 B.I.F. In view of the success of the combined stand at Birmingham, arrangements have been made for a larger stand in 1953.

Attention is drawn to the heavy drop in demand for phenolic and cresylic resins and moulding powders which occurred in the middle of 1952, resulting in supplies and materials being greatly in excess of demand, in contrast to the position in the earlier part of the year when considerable quantities of phenol had to be imported.

Export figures in 1952 with the comparative figures for 1951 and 1950 are shown in the table below, covering plastics materials, plastics not elsewhere specified, and plastics toys, excluding dolls.

The Australian import restrictions are stated to have had a marked effect on some sections of the industry and the severe competition from German and Italian manufacturers is noted.

The work in education and design is recorded, including mention of the Horner's Award, the Bowen (Cables and Plastics) Prize Fund and the Industrial Art Bursaries.

The Report notes the progress that has been made in the compilation of important statistics in the field of moulding powder manufacture, moulding and exports.

Total membership of the Federation as on January 1, 1952, was 259. The figure for January 1, 1953, was 262.

The Report concludes with the schedule of the British Standards Institution Specifications, published during the year dealing with the plastics industry, as follows:—

B.S. 1,885:1952—Synthetic Resin Bonded Paper Insulating Tubes (rectangular cross section) for Electrical Power Circuits up to 1,000 Volts.

B.S. 1,859:1952—Cast Aluminium Saucepans and Frying Pans for Domestic Use. (Note: Plastic heat-insulated handles are used.)

B.S. 1,862 : 1952—Cables for Vehicles.

B.S. 1,810 : 1952—Condenser Bobbins for Mules.

B.S. 1,809 : 1952—Ring Doubling Frame Bobbins for Cotton and Spun Rayon.

B.S. 1,836: 1952—Dimensions of Flyer Bobbins and Skewers.

B.S. 1,834 : 1952—Isopropyl Acetate.

B.S. 1,835 : 1952—2-Ethylhexyl Alcohol.

B.S. 1,811 : 1952—Methods of Test for Wood Chip Boards, Wood Waste Boards and Similar Boards.

Also noted are draft specifications completed within the Federation and sent to the British Standards Institution, on which work has continued within the Federation during the year, and new work on Standardization started by the Federation Committee during the year.

Exports during 1952, with the comparative figures for 1950 and 1951.

	1950	1951	1952
Plastics materials	£9,124,449	£16,322,176	£13,611,528
Tons	35,156	53,123	42,274
Plastics not elsewhere specified	£2,366,113	£2,656,494	£2,179,290
Plastics toys (except dolls)	£447,623	£567,914	£404,305

100... 10,000... 100,000..... 1,000,000

How many knocks can a receiver-bar take?

IT DEPENDS, of course, on the type and quality of the plastic used; which preamble provides us with the opportunity of re-asserting our favourite maxim: the quality of the raw material determines the quality of the finished product. And that suggests one good reason why manufacturers who have built a reputation for producing perfect products demand to be supplied with perfect materials—from East Anglia Plastics.

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PLASTICS DIVISION
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PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2s. 8d. each (including postage).

B.P. 678,264. Linear polyesters. J. W. Fisher, J. Lincoln. To: British Celanese, Ltd.

B.P. 678,287. Phenolic resins. To: Union Carbide and Carbon Corp. (U.S.A.).

Heat-hardenable phenol-formaldehyde resins free from uncombined formaldehyde are made by condensing a phenol and formaldehyde in the ratio 1 : 3 in the presence of a certain alkaline catalyst followed by a certain heat treatment.

B.P. 678,290. Manufacture of collapsible containers from flexible wrapping materials. C. R. Oswin. To: British Cellophane, Ltd.

The container is produced from a transversely cut, permanently creased flexible tube (cellulosic material or thermoplastic material containing an ethylenic bond or a super-polyamide; coated, waxed paper) in which temporary creases are formed as fold lines when the tube is flattened. On returning to its permanent creases, tags remain to facilitate opening.

B.P. 678,468. Production of 2 : 3-dihydrofurans. To: Soc. des Usines Chimiques Rhône-Poulenc (France).

B.P. 678,576. Polymeric hydroxy sulphides, polymeric hydroxy sulphones and processes for their manufacture. A. S. Carpenter, F. Reeder, D. J. Waters. To: Courtaulds, Ltd.

B.P. 678,579. Spectacle frames. T. Hamblin. To: Theodore Hamblin, Ltd.

B.P. 678,600. Adjustable fastening device having a grooved plastic track. N. Statham.

The slider track especially for underwear slide fasteners is made integral with a flexible (plastic) strip for being stitched on.

B.P. 678,641. Collar holder or stiffener. H. A. Proops.

B.P. 678,675. Pliers with insulated handgrips. J. Blum.

The tubular covering has at the end of each grip near the pivot a slip guard in the shape of an arm extending at right angles outwardly.

B.P. 678,717. Method for forming printed circuits and printed circuit elements. B. F. Huggins, M. A. Strivens. To: Plessey Co., Ltd.

The electrically insulating material forming the support for the circuit may be, i.a., a moulded product containing phenol-formaldehyde or aniline-formaldehyde types of condensation products (Bakelite, Tufnol, Panilax), polystyrenes, vinyl chloride-vinyl acetate copolymers, polyvinyl chloride, polyacrylates.

B.P. 678,785. Machines for admixing the ingredients of rubber and like plastic compositions. To: Pirelli Soc.p.A. (Italy).

To enable the use of the machine for operations requiring different temperature gradients, the wall of the rotor chamber is subdivided into sections independently to be supplied with heating or cooling fluid of the required temperature.

B.P. 678,798. Moulding materials for foundry cores and moulds. To: Farbenfabriken Bayer (Germany).

The material contains, besides sand and a thermosetting plastic binder, a certain vitreous substance.

B.P. 678,821. Showcards, window display stands and the like. R. A. Morris. To: W. J. Webster, Ltd.

B.P. 678,827. Musical drums. A. H. Gibson.

The tubular section is built up of laminations of fibrous material with intermediate layers of synthetic resin heat treated under pressure.

B.P. 678,830. Stoppers for heat insulated containers. E. L. Mays.

B.P. 678,889. Fuse and like electrical connection boxes. Georges H. Scholes and Co., Ltd., S. Pearce, F. J. Pearce.

The cover is a plastic moulding with moulded markings (numbers) and opposite each moulded mark a roughened space for lead pencil remarks.

B.P. 678,920. Aqueous polymer dispersions. To: N.V. de Bataafsche Petroleum Maatschappij (Netherlands).

B.P. 678,943. Method of polymerization and products produced thereby. To: N.V. de Bataafsche Petroleum Maatschappij (U.S.A.).

The moulding properties of polymerized mono-olefinic compounds depend to a great extent upon the molecular weight. It was found that many active polymer nuclei form at a temperature of at least 90 degrees C. but below decomposition temperature. The process is described with particular reference to methacrylonitrile.

B.P. 678,986. Nose clips for administering medicines. E. F. Muhlethaler (France).

B.P. 678,989. Emulsions of polyvinyl methyl ketone. To: Celanese Corp. of America (U.S.A.).

B.P. 679,013. Injection-moulding machine. To: A.R.D. Corp. (U.S.A.).

The machine has a storage cylinder for containing a reserve of the moulding composition and an extra plunger to apply pressure to this plunger when the injection plunger reaches a certain position. At the same time, a valve is actuated to open a passage between storage and injection cylinders.

B.P. 679,049. Electric two-part cable couplings. J. E. G. Chapman. To: Brit. Insulated Callender's Cables, Ltd.

B.P. 679,054. Process for coating with aqueous dispersions of polymers. To: E. I. Du Pont de Nemours and Co. (U.S.A.).

The coatings on non-fibrous base materials (regenerated cellulose film) comprise vinylidene chloride polymers.

B.P. 679,091. Method and apparatus for feeding continuous-operation mixers for the ingredients of plastics base (e.g., rubber base) compositions. To: Pirelli Soc.p.A. (Italy).

B.P. 679,117. High potential coils. To: Brit. Thomson-Houston Co., Ltd. (U.S.A.).

The coil is embedded in solid layers of polyethylene, fused and welded together under heat.

B.P. 679,139. Device for mending hosiery. To: Marvel Speciality Co. (U.S.A.).

B.P. 679,143. Styrene modified alkyd resins. To: Dow Chemical Co. (U.S.A.).

B.P. 679,144. Styrene-drying oil modified alkyd resins. To: Dow Chemical Co. (U.S.A.).

B.P. 679,146. Stabilization of halogenated organic compounds. To: N.V. de Bataafsche Petroleum Maatschappij (Netherlands).

Certain epoxy ethers are excellent stabilizers and are not irritant to the human skin, which is of importance in their application in polyvinyl chloride compositions for articles of clothing.

B.P. 679,152. Lamp jacks as used in telephone systems. A. J. Calder, L. F. Wood. To: Siemens Brothers and Co., Ltd.

Special shape of thermosetting plastics moulding.

B.P. 679,177. Extrusion of filament-forming materials. B. J. Upton. To: British Celanese, Ltd.

The material is fed into a space between travelling endless flexible rigidly supported members where the material is compacted. The compacted rod is conveyed by the members to a heated extrusion head.

B.P. 679,184. Production of cellulose carboxy alkyl ethers and salts thereof. To: Gevaert Photo-Producten N.V. (Netherlands).

B.P. 679,212. Pocket lenses. J. W. Phillips, G. Phillips. To: Joseph Lucas, Ltd.

B.P. 679,220. Drinking pot for a bird cage. E. G. Hale, S. A. Hale.

B.P. 679,225. Striking surfaces for safety matches, and materials therefor. T. B. Ledaal (Norway).

The surface comprises equal parts of red phosphorus and polyvinyl chloride.

B.P. 679,257. Commodity bag. D. A. Perino. To: Milprint Inc.

B.P. 679,276. Wrappers for sliding clasp fasteners. E. J. Thomas. To: Flex Fasteners, Ltd.

B.P. 679,281. Method of making filament bristle brushes. To: Pro-Phy-Lac-Tic Brush Co. (U.S.A.).

The brush back and the bristles are made of thermoplastic material, the bonding material is thermosetting, which is heated below the distortion point of the thermoplastic material to secure the bristles in place.

B.P. 679,283. Method of and apparatus for welding electrically thermoplastic sheet material. To: Communications Patents, Ltd. (Switzerland).

The materials are polyvinyl chloride or polythene. Two metal strips clamp overlapping thicknesses of the material which is welded by raising the temperature during a certain period.

B.P. 679,320. Eye shield or goggles. To: Parmelee Plastics Co. (U.S.A.).

B.P. 679,326. Coating compositions. To: N.V. de Bataafsche Petroleum Maatschappij (U.S.A.).

Wrinkled surface patterns are avoided by incorporating with the drying ingredients a calcium or barium salt of a condensation product of octylphenol and formaldehyde.

B.P. 679,369. Manufacture of composite articles. Dunlop Rubber Co., Ltd., W. A. Gurney.

Rubber is bonded to rigid materials (metals, moulded resin products, resin-impregnated asbestos products, laminated paper articles, graphite blocks) through a coating of a heat-hardenable resin (Bakelite, Durez, Aerolite K) on the rigid support and a film between rubber and coating of an organic polyisocyanate.

B.P. 679,373. Fastening device for a garment. N. E. V. Graham.

B.P. 679,374. Process for the production of new copolymers of vinyl phenols. Brit. Resin Products, Ltd., E. M. Evans, J. J. P. Staudinger, J. E. S. Whitney.

A mono-vinyl phenol compound is copolymerized with an acetal or semi-acetal of an unsaturated aldehyde. The resins are suitable where tough, solvent-resisting sheeting, coating, foils, fibres or mouldings are required.

B.P. 679,426. Method of manufacturing optical elements. To: Philips Electrical Industries, Ltd. (Netherlands).

Cellulose acetate butyrate or cellulose acetate propionate is dissolved, cast in a mould and dried.

B.P. 679,437. Spectacle lens wiper. E. W. Edwards.

B.P. 679,443. Dispersions of polymeric materials. To: E. I. du Pont de Nemours and Co. (U.S.A.).

Ethylene polymer derivatives are particularly useful for coating of paper and cloth to increase toughness and resiliency. The polymer is dissolved in an organic solvent and emulsified in presence of water and an emulsifying and dispersing agent. Then the solvent, part of the agent and a portion of the water is removed by evaporation.

B.P. 679,458. Method of producing draw string bags. To: Milprint Inc. (U.S.A.).

B.P. 679,539. Electrostatic capacitors. To: Aerovox Corp. (U.S.A.).

The dielectric thermoset plastic composition which serves as impregnant is a poly-unsaturated alkyd resin. The resin type used for the casing is the same but mixed with inert filler.

B.P. 679,549. Synthetic resinous materials. O. N. Foust, E. G. Seems. To: Brit. United Shoe Machinery Co., Ltd. (U.S.A.).

Microporous synthetic resinous material, which has a warm feel to the hand, is prepared by sintering, in finely divided form, a plurality of different synthetic resins.

B.P. 679,553. Waterproof garments. Research Assoc. of Brit. Rubber Manufacturers. A. L. Soden.

Polythene or plasticized polyvinyl chloride is spread or calendered on to cloth used for making the belts, so that no wear occurs by cloth against cloth.

B.P. 679,562. Polymers and process for the preparation thereof. To: N.V. de Bataafsche Petroleum Maatschappij (U.S.A.).

A mixture of a monomeric olefinic compound (vinyl-type monomer) and a linear polymer (polyisobutylene; polymethylmethacrylate; a polyamide condensation product) is subjected to an agitation treatment. The copolymers retain the properties of the homopolymers of the individual monomers. They may be used for moulded, machined, laminated articles, for coating and impregnating compositions.

B.P. 679,566. Fungi and bacteria resistant polyvinyl chloride compositions. R. W. Malone, Jr. To: Monsanto Chemical Co. (U.S.A.).

B.P. 679,567. Fungi and bacteria resistant polyvinyl chloride compositions. W. F. Field. To: Monsanto Chemical Co. (U.S.A.).

B.P. 679,578. Inflatable life-jackets. R.F.D. Co., Ltd., S. Mitchell.

B.P. 679,580. Frames for mirrors, pictures and other displays. To: N.B. Mouldings, Ltd.

The rectangular moulded plastic frame is provided with a spring metal bridge across the rear holding the ends of a wire support.

B.P. 679,619. Process for the production of ropes from artificial filaments. J. R. Whinfield, Imperial Chemical Industries, Ltd.

A tow is formed from the filaments (nylon; highly polymerized polymethylene terephthalate) as they come from the spinneret without twisting. A number of such tows are used as rope yarn.

B.P. 679,624. Process and device for the manufacture of plastic masses. To: Harvyn Products, Ltd. (Germany).

A thermoplastic synthetic resin (polyvinyl chloride) or a cellulose derivation is mixed as a powder, without the use of pressure, with a plasticizer and heated as powder, without pressure, by radiant heat. The mixing is continued until a sample, on cooling to room temperature, feels dry and is a free-flowing powder.

B.P. 679,655. Stabilized vinyl chloride resins. To: Union Carbide and Carbon Corp. (U.S.A.).

The composition resistant to discoloration by light and heat contains not less than 60 per cent. by weight of vinyl chloride and of 0.5 to 5 per cent. of a hydrocarbon tin alcoholate.

B.P. 679,671. Linear polyurea derivatives. To: Nederlandse Organisatie voor Toegepastnatuurwetenschappelijk Onderzoek ten behoeve van Nijderheid, Handel en Verkeer (Netherlands).

A polymonothiocarbamate is formed and heated to obtain a sulphur-free polyurea derivative. The length of the polymer chain is controlled by the addition of a primary or secondary monoamine.

B.P. 679,691. Surgical footwear. J. Guest.

The false-foot portion consists of a rigid hollow body, e.g., moulded in a thermo-setting resin. Or its elements may be cut and bent to shape from a thermoplastic synthetic-resin sheet and united afterwards.

B.P. 679,693. Impermeable films and their manufacture. To: La Cellophane S.A. (France).

A layer of vinyl chloride and vinylidene chloride is applied to a thin regenerated cellulose base and anchored to it by a melamine-formaldehyde resin.

B.P. 679,708. Method of fixing linings in the nozzles of nozzle-type centrifuges. To: AB Separator (Sweden).

Synthetic resins are used as a cement. Phenolic is suitable and also urea, melamine, casein resins applied as a thermoplastic powder forming a fast joint on heating. The material has to be selected according to its resistance to the attacks of the liquid to be centrifuged.

B.P. 679,727. Manufacture of moisture-proof, heat-sealable sheet wrapping materials. W. Berry, C. R. Oswin, J. Kay. To: British Cellophane, Ltd.

An interpolymer is formed of vinylidene chloride/acrylonitrile/acidic ethylenic-compound.

B.P. 679,722. Manufacture of wound capacitors from metallized dielectric. R. A. Grouse. To: A. H. Hunt (Capacitors), Ltd.

Insulating plastic materials which do not stretch unduly under tensile force are employed instead of paper, e.g., polystyrene, polythene, polyvinyl chloride, polymethyl methacrylate, also cellulose, cellulose acetate and nitrate.

B.P. 679,758. Process for the production of water-soluble condensation products from ureas and aldehydes. To: Deutsche Gold- und Silber-Scheideanstalt (Germany).

B.P. 679,761. Method for dissolving normally gaseous agents in thermoplastic resins. A. Abbey. Com. from: Dow Chemical Co.

The resin is polystyrene and the agent methyl chloride.

B.P. 679,764. Cellulose derivative emulsions. H. Grunwald.

B.P. 679,765. Condensation process and the products resulting therefrom. To: N-V. de Bataafsche Petroleum Maatschappij (U.S.A.).

The process relates to addition products of unsaturated aldehydes and polyethylenic compounds.

B.P. 679,814. Apparatus and method of coating. E. P. Miller. To: H. J., H. G., H. P., and E. M. Ransburg; Harper J. Ransburg Co. (U.S.A.).

Liquid particles are precipitated on a (moving) surface in an electrostatic ionizing field. The method is, e.g., applicable to coating a Cellophane sheet or film with a siccative oil for rendering it moisture proof.

EDWARDS VACUUM COATING PLANT

(*Continued from page 97*)

vapour pump—is a sensitive means of leak detection should any failure occur.

Three safety devices are fitted. A vacuum safety switch (22) when subjected to low pressure closes the circuit from the high tension transformer to the "Variac"; otherwise the chamber is isolated and there is no possibility of shock to the operator when the vacuum chamber door is opened. A magnetic valve (25) mounted directly above the pump is connected to the motor starter circuit. While current is on the valve remains open; should the current fail the valve closes and prevents pump oil being forced into the system under vacuum. A magnetic water valve is in circuit with the vapour pump heater, and water automatically starts flowing through the vapour pump cooling coils when the heater is switched on.

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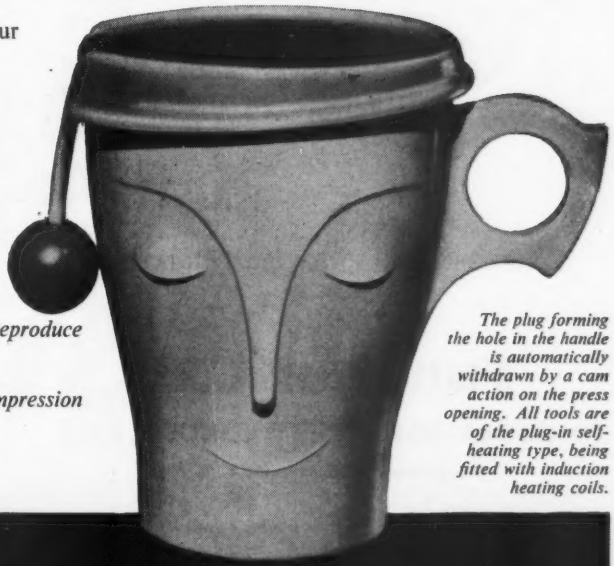
Five of these moulds were required, as well as two nine-impression moulds for the blue cap and one thirty-seven impression mould for the bobble.



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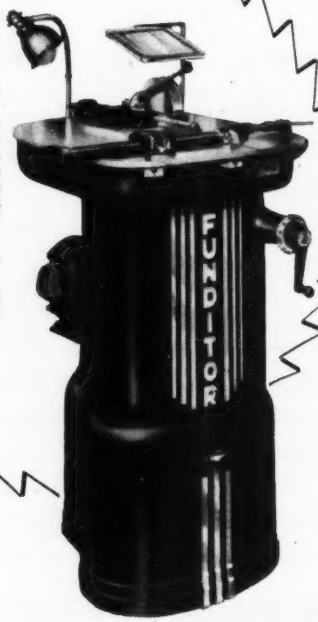

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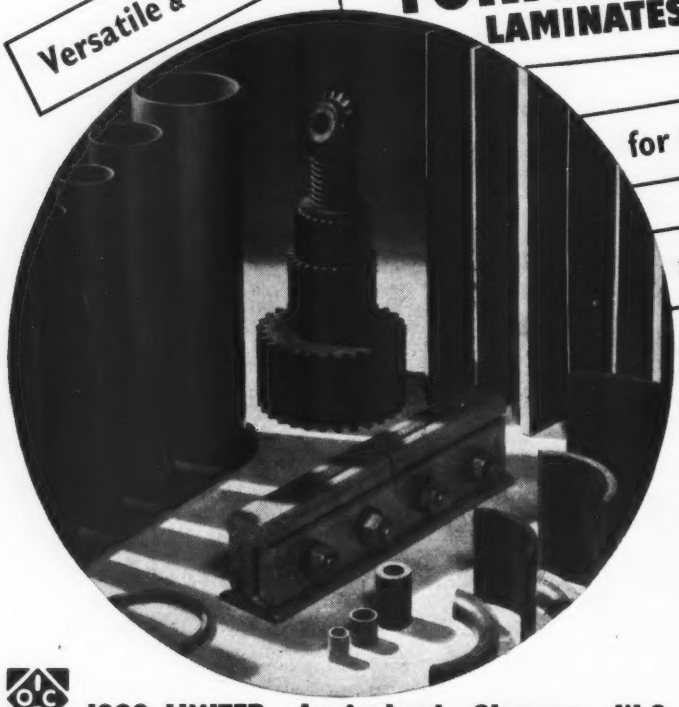

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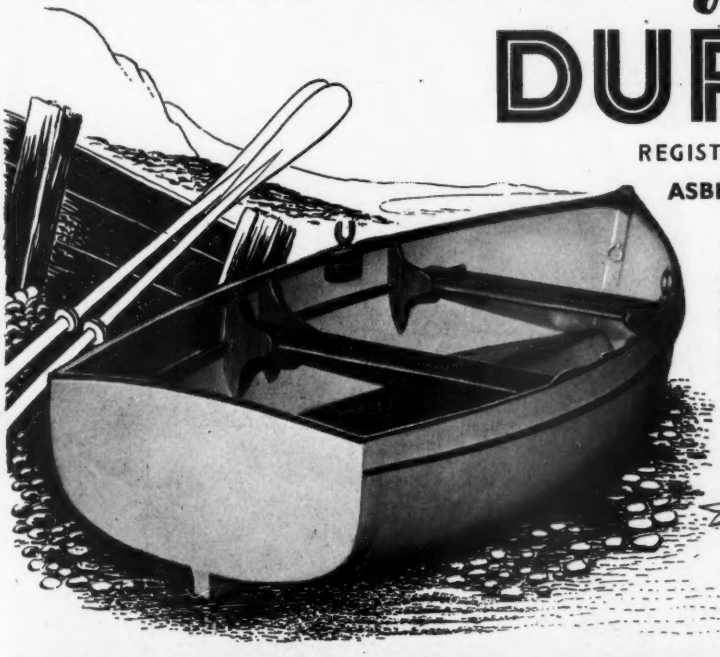

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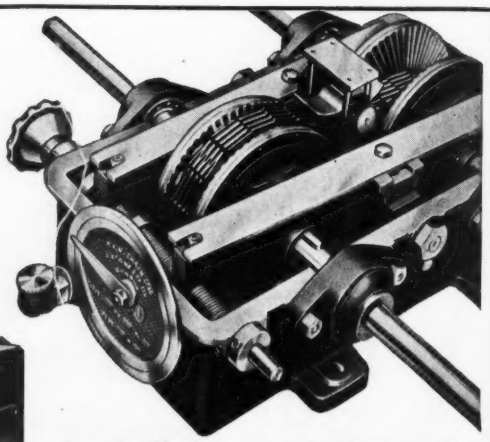

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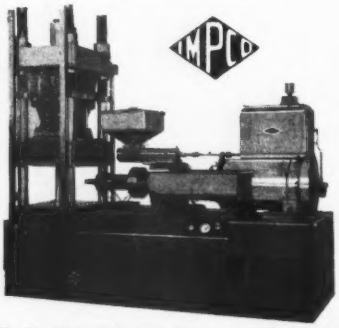

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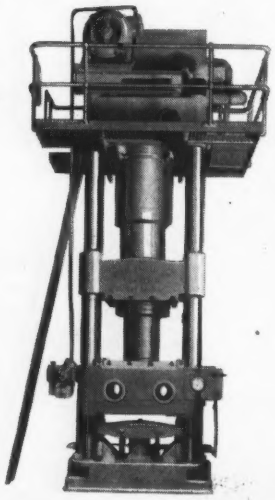

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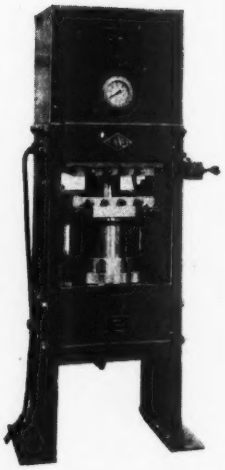

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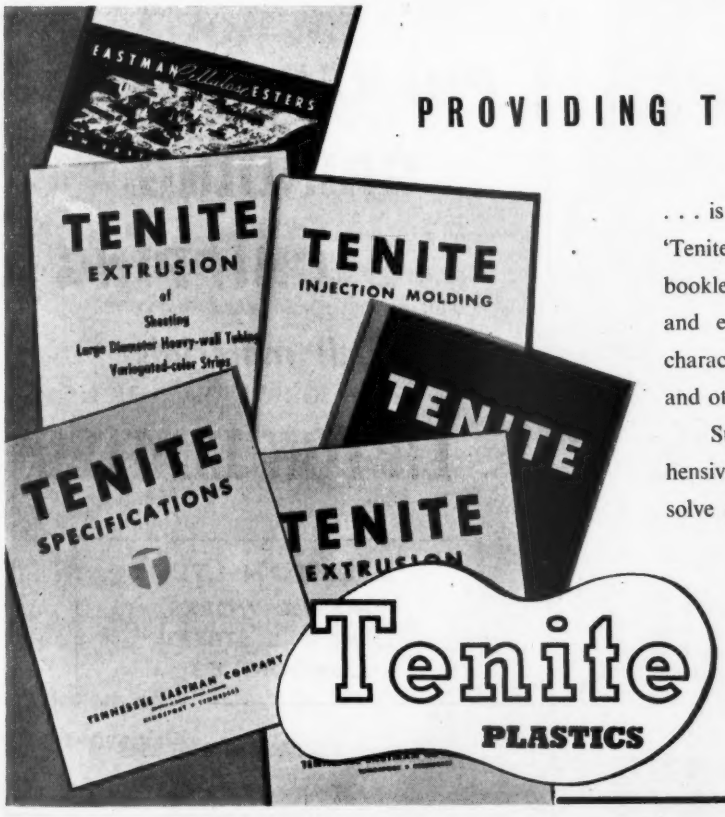

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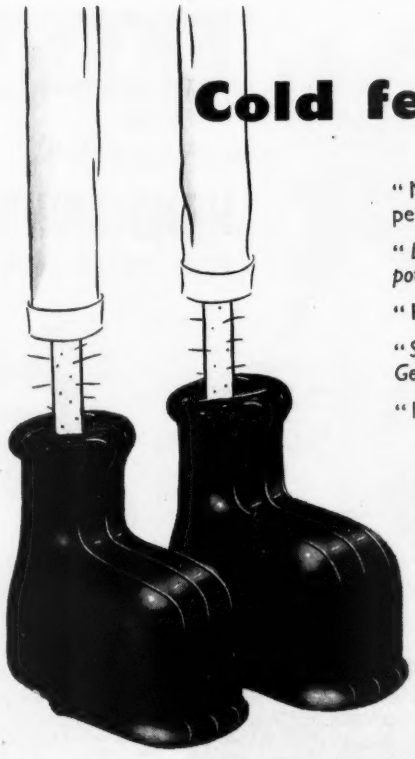

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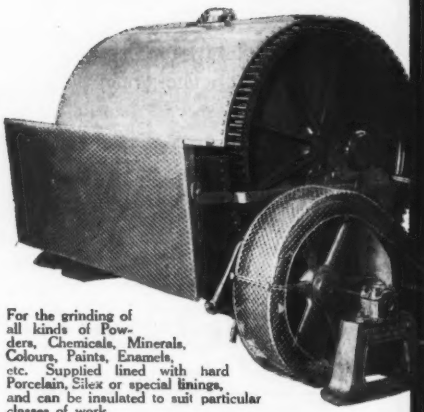

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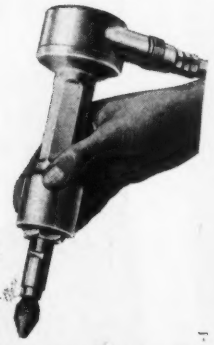

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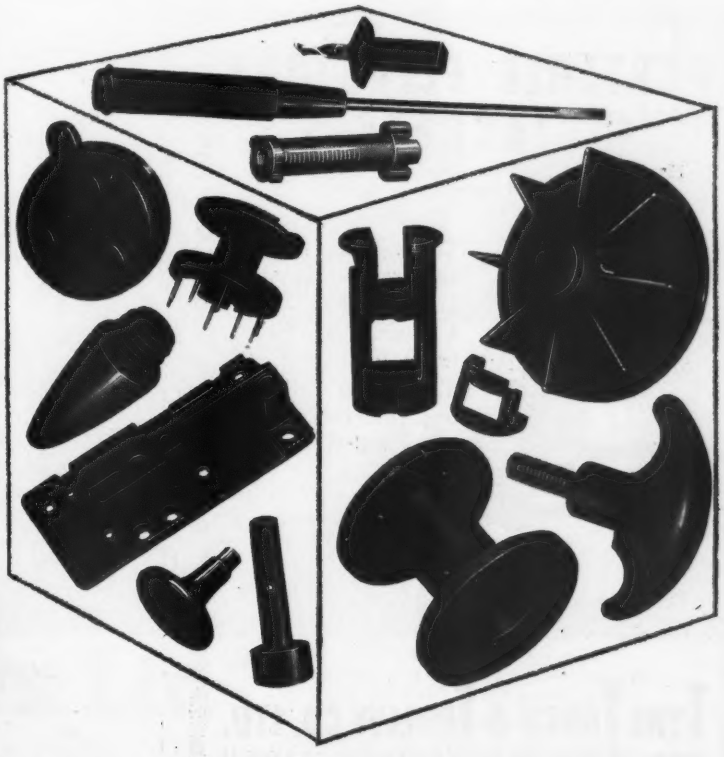

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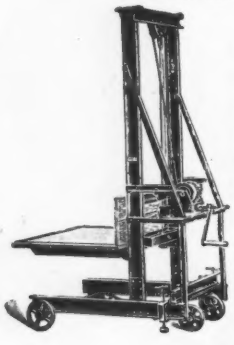

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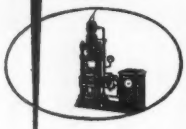

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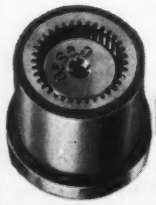

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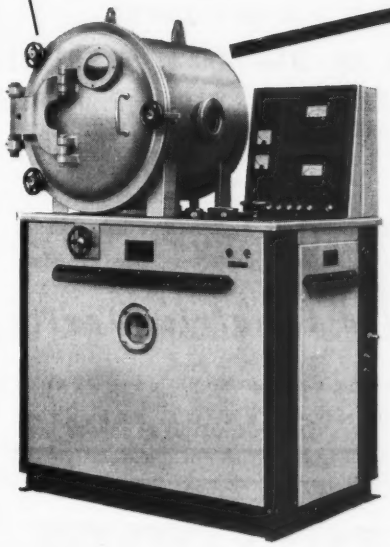

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INDEX TO ADVERTISERS

Name	Page
A	
Abril Corporation (Gt. Britain) Ltd.	62
Albright & Wilson, Ltd.	56
Ashdowns, Ltd.	43
B	
Bakelite, Ltd.	38
Bakelite, Ltd. (Vybak)	Back Cover
Baldwin Instrument Co., Ltd., The	52
Ball, W. W., & Sons, Ltd.	6
Barber & Duffy, Ltd.	63
B.I.P. Engineering, Ltd.	22
B.I.P. Tools, Ltd.	42a
Birkby's Ltd.	13
B.L.C. (Exports), Ltd.	62
Bridge, David, & Co., Ltd.	26
Bridges, S. N., & Co. Ltd.	29
Briggs Bros. & Co.	54
British Celanese, Ltd.	42
British Electrical Development Association	36
British Ermeto Corporation, Ltd.	51
British Geon, Ltd.	31
British Moulded Plastics, Ltd.	40
British Resin Products, Ltd.	7
BX Plastics, Ltd.	Front Cover
Byson Appliance Co., Ltd.	60
C	
Calderon, M., Ltd.	63
Castle, John, & Co., Ltd.	62
Ceramic Platers, Ltd.	66
Chamberlain & Willows	63
Chase, Bernard	5
Clifford Covering Co., Ltd.	35
Cohen, George, Sons, & Co., Ltd.	53
Coldwell, W. B., & Sons, Ltd.	60
Cole, E. K., Ltd.	3
Cole, R. H., & Co., Ltd.	37
Crompton Parkinson, Ltd.	16
D	
Davis & Timmins, Ltd.	50
Dowding & Doll, Ltd.	15
Duratube & Wire, Ltd.	44
E	
East Anglia Plastics, Ltd.	41
Ebonestos Industries Ltd.	33
Edwards, W., & Co. (London) Ltd.	61
Erinoid, Ltd.	Inside Front Cover
Ether, Ltd.	61
Evans, Frederick W., Ltd.	62
Evode, Ltd.	52
F	
Ferguson, James, & Sons, Ltd.	28, 42b
Finney Presses Ltd.	48
Firth Brown Tools, Ltd.	20
Flextol Engineering Co., Ltd.	63
Funditor Ltd.	42b
G	
Gas Council, The	12
General Electric Co., Ltd., The	8
Gosheron, John, & Co., Ltd.	48
Greenwich Leathercloth Co., Ltd., The	25
H	
Hellerman, Ltd.	53
Hupfield Bros., Ltd.	34
I	
Imperial Chemical Industries, Ltd.	Inside Back Cover
Industrial Plastics, Ltd.	58
Injection Moulders, Ltd.	30
Insulators, Ltd.	57
Ioco, Ltd.	44
J	
Johnson, Matthey & Co., Ltd.	9
K	
Kays Industries Ltd.	59
Kent Mouldings	51
Kenure, J. F., Ltd.	52
Kleemann, O. & M., Ltd.	23
Kodak, Ltd.	49
L	
Lipton, L., Ltd.	50
London & Scandinavian Metallurgical Co., Ltd.	60
M	
Marshall, C., & C., Ltd.	66
Melwood Thermoplastics Ltd.	58
Micanite & Insulators Co., Ltd., The	27
Mining & Chemical Products, Ltd.	2
Monsanto Chemicals, Ltd.	10, 11
N	
Nu-Swift, Ltd.	60
P	
Perkins & Seward, Ltd.	58
Plastic Engineers, Ltd.	45
Polythene, Ltd.	56
Projectile & Engineering Co., Ltd., The	24
Pure Chemicals, Ltd.	50
R	
Radio Heaters, Ltd.	61
Reliance Trading Company	62
Resinous Chemicals, Ltd.	32
Rootes Mouldings, Ltd.	55
Rubber Improvement, Ltd.	54
Rue, Thomas De La, & Co., Ltd.	21
S	
Shell Chemicals, Ltd.	18
Steele & Cowlishaw, Ltd.	54
Stevens, Michael S.	62
Stone-Wallwork	46
T	
Tant, W. H., & Co., Ltd.	59
Thermo-Plastics, Ltd.	17
Todd Bros (St. Helens & Widnes) Ltd.	1
Turner Bros. Asbestos Co., Ltd.	45
Tyne Truck & Trolley Co. Ltd.	56
U	
United Ebonite & Lorival, Ltd.	19
Universal Metal Products, Ltd.	47
Universal Tools, Ltd.	49
Utilex, Ltd.	46
V	
Vinyl Products, Ltd.	
W	
Whiting, L., Ltd.	63

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P.518

Vol. XVIII. No. 188. Plastics MARCH, 1953

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